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TWITTER'S/X'S ROLE IN BUSINESS AND SOCIETY: PAST, PRESENT AND FUTURE

Διπλωματική Εργασία

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Θεόδωρου Γκολφινόπουλου

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Διπλωματική Εργασία

υποβαλλόμενη για τη μερική εκπλήρωση των απαιτήσεων του

ΜΕΤΑΠΤΥΧΙΑΚΟΥ ΤΙΤΛΟΥ ΣΠΟΥΔΩΝ ΣΤΗΝ ΕΦΑΡΜΟΣΜΕΝΗ ΠΛΗΡΟΦΟΡΙΚΗ

Επιβλέπουσα Καθηγητρια
Μάρω Βλαχοπούλου

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Abstract

In the ever-evolving landscape of digital communication, social media platforms have become vital elements in the way humans interact, share information, and even shape public opinion. Twitter, in particular, has been the subject of extensive academic inquiry given its widespread influence on various facets of modern society. Based on an extended literature review the evolving role of Twitter in business and society from its inception to its current state and anticipated future within the context of the Metaverse has been explored. Initially, the review examines historical studies that underscore Twitter's profound influence on communication, notably in information sharing, social activism, political expression, and its pivotal role in marketing and advertising. As we transition to recent studies, there is an emphasis on how Twitter has morphed into a crucial platform for news dissemination, fostering community building, gauging public sentiment, and playing a significant role in crisis communication and emergency response. The review culminates with an exploration of the Metaverse, shedding light on its concept and the potential interplay between Twitter and this emergent virtual universe. Collectively, this synthesis underscores the multifaceted role of Twitter, reaffirming its continued significance in the contemporary digital age and projecting its potential implications in the forthcoming Metaverse era.

Keywords: Twitter, Metaverse, Microblogging, Social Media

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1 Introduction

Microblogging is a relatively new phenomenon that refers to a type of blogging where individuals can post short updates about their lives, typically comprising less than 200 characters. These updates can be shared with friends and followers through various channels such as text messaging, instant messaging, email, or the internet (Java et al., 2007). It has become a popular form of online communication where users post short content such as phrases, comments, images, or links to videos. Examples of microblogging platforms include Twitter, Tumblr, and Plurk, as well as social networking sites like Facebook, Myspace, Google+, and LinkedIn, which have their own microblogging feature called "status updates." This form of online communication is often used for sharing news, promoting political views, marketing, and keeping track of real-time events (Stieglitz and Dang-Xuan, 2013a). Microblogging is a faster mode of communication compared to regular blogging, primarily due to its emphasis on shorter posts that require less time and effort for content generation. Additionally, microbloggers tend to update their feeds more frequently than traditional bloggers, with several updates possible in a single day (Java et al., 2007) .

Twitter was launched in June 2006, allowing users to send 140-character messages (tweets) that were publicly available to other users who chose to follow them (Hine, 2020). By following other users, they can establish social connections and receive their tweets on their homepage, where they can interact by retweeting or replying to them (Tang and Hu, 2020). Following one or more accounts on a platform allows users to create a personalized feed that combines the content from those accounts into a single, private stream (Conover et al., 2013). The platform evolved to include features such as grouping related tweets using hashtags and retweeting messages to followers, resulting in rapid message dissemination. Twitter's popularity grew rapidly, boasting 140 million users by 2012 (Hine, 2020). Tweets are comments limited to 140 characters prior to October 2018 and now 280 characters. Unless tweets are made private, they are publicly available and Twitter users can react and engage with them by retweeting, liking, tagging others, or responding to the author (Karami et al., 2020).

Twitter is a social media platform that allows for online communication and shapes an emerging social structure. It boasts 1.3 billion accounts and 336 million active users, who collectively post 500 million tweets per day. (Karami et al., 2020). The platform played a significant role in several high-profile events, including the Arab Spring uprisings, UK riots in 2011, and the Occupy movement. Additionally, Twitter has been involved in legal cases concerning the breach of celebrity injunctions. Its ability to rapidly spread messages has enabled democratized public communication, bypassing conventional mass media control (Hine, 2020). With over 300 million monthly active users, Twitter is among the most widely used social media platforms. It has become a valuable source of information about real-life events, as it has no restrictions on what users can post and spreads messages almost instantly. For example, Twitter reported an earthquake in Morgan Hill, California, 19 seconds faster than the official Northern California Seismic Network (Karami et al., 2020). Hashtags have proven to be useful in emergency situations such as the earthquakes in Christchurch and floods in Queensland in 2011. They were first popularized during the coverage of wildfires in San Diego in 2007 before becoming a part of Twitter's architecture. Hashtags allow for discussions to form organically without any one organization or user controlling them. While key figures such as politicians, journalists, and emergency authorities may participate, any account can use or ignore hashtags in their tweets (Bruns et al., 2013).

Twitter has also provided Application Programming Interfaces (APIs) to facilitate data collection. In order to collect data from Twitter, users can apply for a developer account and obtain four keys - consumer key, consumer secret, access token, and access secret - which allow them to authenticate and access Twitter data such as tweets and profile information. Twitter's API is considered the most effective tool for collecting data on user interactions. This diverse and relevant data source is used by researchers and policymakers alike, representing a wide range of demographic categories (Karami et al., 2020). Twitter's public APIs allow users to capture data of interest, such as real-time feeds or short-term historical tweets, by specific keywords. By applying event detection techniques to Twitter data, researchers can identify recent events, determine their importance, and analyze their temporal and spatial patterns (Tang and Hu, 2020).

The overarching aim of this study is to provide a comprehensive analysis of Twitter's role in business and society, spanning its past impact, current relevance, and potential future applications. The study aims to build upon existing literature by offering a thorough review and critical analysis of each domain where Twitter holds influence. Additionally, this study aspires to bridge gaps in current knowledge by exploring emerging areas where Twitter has started to mark its footprint. In doing so, the study seeks to serve as a foundational reference for scholars, practitioners, policymakers, and the general public interested in the nuanced impacts of social media platforms like Twitter.

This literature review utilizes a systematic approach to examine the multifaceted roles of Twitter in society and business, both historically and in modern contexts. Scholarly articles, academic journals, and case studies were sourced from established databases such as Google Scholar. These works were then categorized into themes that correspond with the study's main focus areas: past, present, and future implications of Twitter in sectors like communication, social activism, marketing, and emerging trends like the Metaverse. Each chapter incorporates a table summarizing key aspects of the studies reviewed, such as their methodologies, primary findings, and implications. By collating diverse perspectives, this study aims to furnish a comprehensive, evidence-based overview of Twitter's evolving impact across different domains.

This thesis is structured to offer a thorough analysis of Twitter's multifaceted role, focusing predominantly on an extensive literature review as its core. The review is compartmentalized into three distinct subsections: Twitter's historical roles, its current applications, and its future potential in emerging technologies like the Metaverse. Each subsection is further divided into specific focus areas, such as communication, activism, and crisis management. The study culminates in a concluding section that synthesizes the key findings across these domains, providing an integrated perspective and suggesting avenues for future research.

2 Literature Review

The conducted literature review aims to provide a comprehensive overview of existing research on the use of Twitter, from its impact on communication and information sharing to its role in more nuanced fields like political communication, social activism, and marketing. Additionally, this review will shed light on recent studies that delve into the current use-cases of Twitter, including news dissemination, community building, sentiment analysis, and crisis communication.

The first part of the literature review will focus on foundational studies that have examined Twitter's role in the past, outlining key themes such as its impact on communication paradigms, its significance in the realm of social activism and politics, and its utility in marketing and advertising. The aim is to establish a framework for understanding the platform's influence in shaping interpersonal and societal interactions.
The second section will turn to more recent scholarship to understand how Twitter's role is changing or evolving. This includes a look at how it serves as a conduit for news and information sharing in real-time, its growing importance in building social communities, and the increasingly sophisticated ways it is being used to gauge public opinion. We will also explore the vital role Twitter plays in crisis communication and emergency response.

Following the literature review, Chapter C will delve into an emerging concept—The Metaverse—and examine its potential implications, further establishing the role and relevance of digital platforms like Twitter in shaping our future.

2.1 Studies on the use of Twitter in the past

Twitter, conceived in 2006 by Dorsey, Glass, Stone, and Williams, quickly metamorphosed from a humble platform for micro-blogs to a globally influential communication tool (Vanian, 2022). In its nascent stage, Twitter experienced rapid acceptance, a trajectory that was buoyed by memorable instances like Ashton Kutcher's endorsement and the unique experience of an astronaut tweeting from the vastness of

space[1]. Interestingly, it was Dorsey's vision to craft a platform for sharing concise text messages, initially setting a restriction at 140 characters (Bullas, 2023).

One groundbreaking feature that elevated Twitter's functionality was the hashtag, introduced to streamline tweet categorization and searchability. By 2012, Twitter was a powerhouse with 140 million users actively churning out 340 million tweets every day (Bullas, 2023). It was during this period that Twitter's capacity to relay real-time news began making waves, evidenced significantly during global events like the Arab Spring. Its influence reached a pinnacle when President Barack Obama chose the platform to announce his 2012 electoral victory, marking a transformation in how politicians would utilize social media (Vanian, 2022).

As Twitter's stature grew, challenges came to the forefront. The platform grappled with internal managerial unrest, stagnating user growth, and fierce rivalry from other tech giants (Vanian, 2022). Efforts to rejuvenate the platform included a 2010 redesign that integrated rich media, thereby enhancing user engagement[2]. Yet, monetization remained elusive until 2017. Questions over its credibility were raised, primarily due to the prevalence of bot accounts, which not only skewed metrics but were occasionally embroiled in controversial information drives (Bullas, 2023).

Twitter's policies, especially in the realm of content moderation, drew both acclaim and criticism (Vanian, 2022). Accusations of political bias, especially concerning President Trump’s prolific usage and the eventual temporary suspension of his account, amplified debates around technology, free speech, and governance (Bullas, 2023). This was further complicated by the direct influence some tweets, like those from Trump, had on real-world events such as stock market movements (Vanian, 2022).

However, challenges intensified around 2020. The Covid-19 pandemic exacerbated misinformation woes and a major hacking incident rang security alarms, underscoring the vulnerabilities inherent in digital platforms. Yet, amidst the adversities and triumphs, Twitter stands as a testament to both the opportunities and challenges of social media in our digital epoch (Vanian, 2022).

Originating in 2006 as a simple microblogging platform, Twitter has grown to play a pivotal role in global communication paradigms. Its influence permeates diverse sectors, from facilitating novel communication dynamics to serving as a conduit for political discourse and commercial outreach. This chapter undertakes a scholarly examination of Twitter's historical trajectory, elucidating its multifaceted impact on communication, political landscapes, and marketing arenas.

2.1.1 Twitter's impact on communication and information sharing

In the digital age, social media platforms have become powerful tools for communication and information dissemination. Among these platforms, Twitter stands as a prominent force, shaping how people share and receive information on a global scale. From nonprofit organizations leveraging the platform to engage with stakeholders, to the instantaneous spread of breaking news stories, Twitter has irrevocably altered the ways in which we communicate and access information. This chapter delves into the multifaceted impacts of Twitter on communication and information sharing, guided by various insightful studies.

A study by Lovejoy et al. examines the use of Twitter by nonprofit organizations for sharing information and engaging with stakeholders. According to the article, Twitter is a useful platform for nonprofits to reach a wider audience, share news and updates, and connect with others who share their mission. Nonprofits can use Twitter to share a variety of information, including updates on programs and services, fundraising appeals, and information about events and campaigns. Twitter also allows nonprofits to share multimedia content and solicit feedback from stakeholders. Hashtags are a valuable tool for nonprofits on Twitter, allowing organizations to join larger conversations and reach a wider audience. Nonprofits should develop a clear strategy and prioritize engagement on Twitter by responding to questions and comments in a timely and authentic manner (Lovejoy et al., 2012).

Kwak et al. found that Twitter has facilitated the spread of news and information in real-time. The study found that during breaking news events, Twitter was often the first source of information for many individuals. This has led to the emergence of citizen journalists who report on events in real-time, often before traditional media outlets

(Kwak et al., 2010). According to a study by (Hermida et al., 2014) Twitter is becoming an increasingly important platform for breaking news, with many news organizations using it as a tool for gathering and disseminating information. The study found that Twitter is particularly effective at breaking news stories that are happening in real-time, with many users sharing information about events as they happen. A study by Papacharissi and de Fatima Oliveira (2012) found that Twitter's open and public nature can lead to the spread of misinformation and rumors. The study found that during crises, such as natural disasters, rumors and false information can quickly spread on Twitter, causing confusion and potentially harmful actions. Furthermore, Java et al. (2007) found that Twitter's short message format encourages users to express their thoughts and ideas in a concise and direct manner. This characteristic of Twitter has made it a popular tool for political campaigns, social movements, and citizen journalism. Twitter has also been used to share information and personal experiences related to mental health. In specific a study by Birnbaum et al. (2019) examined the use of Twitter for mental health support and found that the platform can be a valuable resource for individuals seeking information and support for mental health issues. The study also found that Twitter can help reduce the stigma associated with mental health by promoting open and honest discussions.

Social media platforms, particularly Twitter, have significantly influenced communication and information distribution in recent years. A range of academic studies have explored Twitter's multifaceted impacts, from its role in news dissemination to its utility for nonprofit organizations and mental health discussions. The table below summarizes key findings from several notable studies on this topic.

Table 1 **:** Twitter's impact on communication and information sharing

Author(s) - Year	**Title**	**Point of Article**	**Basic Findings**	**Research Method**
Java et al. (2007)	Why we twitter: understanding microblogging	Why we twitter: understanding microblogging usage and	Twitter’s short message format encourages concise expression, popular	Primary search

	usage and communities	communities	for political campaigns and more.	
Kwak et al. (2010)	What is Twitter, a social network or a news media?	Twitter's Role in Spreading News and Information	Twitter facilitates the real-time spread of news and information, often ahead of traditional media.	Primary search
Lovejoy et al. (2012)	Engaging stakeholders through Twitter: How nonprofit organizations are getting more out of 140 characters or less.	Use of Twitter by Nonprofit Organizations	Twitter is a useful platform for nonprofits to reach wider audiences and engage with stakeholders.	Primary search
Papacharissi & de Fatima Oliveira (2012)	Affective News and Networked Publics: The Rhythms of News Storytelling on #Egypt.	The Spread of Misinformation and Rumors on Twitter	During crises, Twitter's public nature can lead to the rapid spread of rumors and false information.	Primary search
Hermida et al. (2014)	A Case Study of Andy Carvin's Sources on Twitter During the	Twitter as a Platform for Breaking News	Twitter is an important platform for breaking news, used by many news organizations.	Primary search

	Tunisian and Egyptian Revolutions.			
Birnbaum et al. (2019)	A Taxonomy of Ethical Tensions in Inferring Mental Health States from Social Media	Use of Twitter for Mental Health Support	Twitter can be a valuable resource for individuals seeking information and support for mental health.	Literature review

2.1.2 Twitter as a tool for social activism and political expression

In a world where technology and social media increasingly shape public discourse, Twitter emerges as a potent tool for political expression and social activism. This platform, known for its brevity and real-time updates, has become a central stage for the organization and dissemination of information for various social movements and political protests around the globe. In this chapter, we will explore the intricate relationship between Twitter and social activism, examining how this platform has been utilized to catalyze political change and to foster connections among like-minded individuals. The discussion begins with an exploration of the role Twitter played in significant global events, such as the 2020 protests following the killing of George Floyd and the Arab Spring uprisings of 2011, which witnessed extensive anti-government protests in several Middle Eastern and North African countries.

Social movements can potentially derive various benefits from utilizing the Twitter platform and other information communication technologies. One of the most significant advantages is the ability to facilitate connections between individuals for the purposes of resource mobilization and collective framing (Conover et al., 2013). Twitter has also been used as a tool for social activism and mobilization. For example, in the wake of the killing of George Floyd in 2020, Twitter was used to organize and share information about protests and calls for racial justice. During the Arab uprisings in 2011, also known as the Arab Spring, Western press coverage of the events heavily emphasized the role of

technology. Many articles questioned whether social media platforms like Twitter and Facebook were the driving force behind these movements, and some even coined terms such as "Twitter revolutions" or "Facebook uprisings". Tufekci (2018) found that Twitter played a crucial role in the Arab Spring uprisings, serving as a platform for activists to organize and coordinate protests and share information with the broader public. Tufekci discusses how Twitter was a key tool for communication and mobilization during the Tahrir Square protests. Twitter was particularly useful for sharing information about the protests, including news and images that were not being reported by state-controlled media. The hashtag #jan25, which was used to organize and share information about the protests, became a global trend on Twitter. Tufekci discusses how Twitter played a significant role in allowing protesters to share information and organize during the election protests. Twitter was particularly useful for sharing information that the government-controlled media was censoring or not reporting, and for coordinating activities across different locations. Tufekci also discusses the challenges of using Twitter as a tool for political organizing. While Twitter was useful for mobilizing people and sharing information, it did not necessarily lead to concrete political change or reform. Tufekci argues that social media tools like Twitter can be useful for organizing protests and creating networks of activists.

The 2011 Arab Spring was characterized by massive anti-government movements across nations like Libya, Tunisia, Bahrain, and Syria, leading to shifts in power structures. Social media platforms, notably Twitter, were crucial in mobilizing support, sharing on-ground footage, and fostering global engagement through hashtags such as #egypt and #libya. Such tags fostered international discussions, ranging from direct participation to global commentary, embodying the essence of ambient journalism. While Twitter has been pivotal in various socio-political landscapes, its definitive impact remains contested. The 2009 Iranian election protests, termed the "Twitter revolution" due to the prevalent use of #iranelection, underscores this debate. During the Arab Spring, even as countries like Egypt and Libya curbed internet access, protestors innovatively bypassed these constraints, sharing real-time updates and videos, especially after the Egyptian restrictions were lifted. Hashtags, by design, widened the discourse, allowing anyone to contribute regardless of their geographic location or involvement level. For instance, the #jan25 tag symbolized Egypt's pivotal 'Day of Revolt.' Though its significance is clear,

this specific hashtag's detailed analysis remains outside the scope of the cited study. (Bruns et al., 2013).

A study by Conover et al. (2013) examines the engagement of Occupy participants with Twitter between September 2011 and September 2012. The analysis shows a significant decrease in Occupy-related traffic on the platform, even after concerted attempts to revive engagement. As a result, the study shifts its focus to Occupy participants themselves, using a sample of 25,000 Twitter users to study changes in behavior at the individual level. The analysis finds that Occupy attracted a highly interconnected community of users with pre-existing interests in domestic politics and foreign social movements. Although there were statistically significant changes in political interests and social connectivity among participants over the study period, the magnitude of these changes was minor compared to the attention allocated to the Occupy movement. The study concludes that, on Twitter, the Occupy movement appealed primarily to a group of highly vocal users who eventually lost interest in Occupy-related communication. These findings can contribute to a better understanding of social movements' use of online platforms and the dynamics of user engagement over time (Conover et al., 2013).

Amidst the backdrop of a technologically-driven era, Twitter has evolved into a compelling medium for social activism and political discourse. Harnessing its real-time communication capabilities, the platform has witnessed and driven pivotal global movements such as the 2020 racial justice protests and the 2011 Arab Spring. The subsequent table provides an overview of seminal research exploring the profound interplay between Twitter, political expression, and social activism.

Table 2 : Twitter as a tool for social activism and political expression

Author - Year	**Title**	**Point of the Article**	**Basic Findings**	**Research Method**
Bruns et al. (2013)	The Arab Spring and Social Media Audiences:	Studies the use of hashtags in discussions about the Arab	The hashtags #egypt and #libya were used to connect comments to a wider discussion on	Primary search

	English and Arabic Twitter Users and Their Networks	Spring uprisings	Twitter. This was used by people regardless of their proximity or involvement in the uprisings	
Conover et al. (2013)	The Digital Evolution of Occupy Wall Street	Examines engagement of Occupy participants with Twitter	Significant decrease in Occupy-related traffic on Twitter. The Occupy movement primarily appealed to a pre-existing, highly vocal group of users who eventually lost interest in Occupy-related communication	Primary search
Tufekci (2018)	How social media took us from Tahrir Square to Donald Trump	Analyzes the role of Twitter in Arab Spring uprisings	Twitter played a crucial role in organizing and coordinating protests, and in sharing information the state-controlled media wasn't reporting. However, it did not necessarily lead to concrete political change	Literature review

2.1.3 Twitter's role in political communication

In an increasingly interconnected world, the influence of social media platforms on political discourse is hard to overstate. This chapter delves into the intricate relationship between Twitter, a platform that boasts hundreds of millions of users globally, and political communication. Twitter, along with other social media platforms like Facebook, has witnessed explosive growth in recent years and has become a central player in the

political arena. Politicians, political parties, advocacy groups, and everyday citizens alike are turning to Twitter to express their views, mobilize support, and engage in direct dialogue with the public. This phenomenon is not limited to any single country; it is pervasive across modern democracies around the globe. As the political landscape evolves, so too does the manner in which political figures and institutions communicate with the public. It examines the diverse ways in which political actors are using Twitter, not only as a platform for self-expression but also as a strategic tool during election campaigns. It provides a comprehensive understanding of the phenomenon colloquially known as technoactivism, where engaged citizens, politicians, and political institutions use blogs and tweets as avenues for democratic expression and networking. However, the use of Twitter in political communication is not without its challenges. As political actors seek to control their message while engaging with a broad audience, they must navigate a delicate balance between interactivity and control. This chapter also offers a critical look at how Twitter, while allowing for broadening public debate, may also serve to amplify existing voices rather than introducing new perspectives. We consider key studies that reveal a complex picture of Twitter's role in the political environment, challenging the notion that Twitter activity always mirrors political reality. Through in-depth analysis, this chapter sheds light on key questions: How are political messages crafted and received on Twitter? How does the use of Twitter by political actors influence voter behavior and public opinion? What role does sentiment play in the retweet behavior of political tweets? And critically, as Twitter continues to shape political discourse, what are the implications for democratic engagement and the future of political communication?

Social media platforms like Twitter and Facebook have experienced remarkable growth and are increasingly being used in the political context by citizens and political institutions such as politicians, political parties, political foundations, and think tanks. Political institutions find it crucial to actively participate in political communication using social media, especially during election campaigns. This is because social media offers a perfect avenue and information source to measure public opinion on policies and political stances, as well as to garner community support for candidates vying for public office. Politicians in modern democracies around the globe have embraced social media, allowing them to engage directly with their constituents, initiate meaningful

conversations with citizens, and foster dynamic political debates in a relatively short period (Stieglitz and Dang-Xuan, 2013b). Individuals with an interest in politics who participate in blogging have been termed as technoactivists seeking avenues for democratic self-expression and networking. The use of blogs has been shown to be a significant factor in online political engagement, and motives for blogging seem to extend beyond intrinsic motivations (Larsson and Moe, 2012). Political parties and candidates have also joined the blogosphere to engage with their supporters and the wider public. While this has created new channels for politicians to connect with an increasingly disillusioned electorate, many political actors have faced challenges in adapting to the new medium. Due to the tradeoff between information control and interactive engagement, political actors tend to be cautious when venturing online, limiting options for voter co-creation and interaction and relying more on traditional informative features. As a result, most online political activity has been described as resembling an electronic brochure, indicating a lack of adaptation to the online format (Larsson and Moe, 2012).

Larsson and Moe's research on the 2010 Swedish election explored how Twitter was utilized. They observed that Twitter engagement was often influenced by events covered in the media, such as TV debates and offline happenings. While Twitter seemed to expand the scope of public discussions, it remained uncertain if it introduced fresh viewpoints or simply provided another platform for already prominent voices in society. The majority of active Twitter users during this period were politicians, well-known journalists, and bloggers. Furthermore, a limited number of users actively tweeted about the election. Most Twitter interactions consisted of general messages, with less emphasis on its conversational and sharing capabilities. Even though major political figures and parties found it challenging to embrace the interactive and networking facets of Twitter, these tools seemed more significant for lesser-known political entities. However, it's noteworthy that only a fraction of the Swedish population was actively using Twitter during this time. (Larsson and Moe, 2012).

Users on Twitter tend to respond strongly to events highlighted by the media, particularly those of a political nature or internet-related controversies. However, solely basing research on peaks in Twitter activity might overlook other significant occurrences. The

discussions on Twitter don't always mirror the broader political landscape, and there are noticeable differences between concerns raised on Twitter and topics covered on television news. It indicates that Twitter's portrayal of the political sphere might not align perfectly with conventional measures. Therefore, it's essential to be wary when using Twitter as a sole representation of the political climate. It's vital to recognize that there might be inherent biases in how digital platforms like Twitter shape our view of reality. To get a more accurate understanding of society and politics using digital indicators, we need to delve into how these platforms process and present information. (Jungherr et al., 2016).

Various research initiatives have delved into Twitter's role in shaping political discussions, spanning both within and outside legislative arenas. Within the U.S., Golbeck et al. (2010) scoured thousands of tweets by Congressional members and deduced a dominant trend: the platform was frequently used for individual publicity. This was evident as officials often shared media pieces about themselves or detailed their daily pursuits. During the U.S. Senate campaigns in 2010, Ammann (2010) highlighted the disparity in Twitter use, which seemed influenced by factors such as the candidate's financial backing, the population of the state they represented, and the intensity of their electoral battle. Intriguingly, the combined tweets from candidates correlated with increased voter participation, with each tweet slightly boosting the turnout of potential voters by 0.02%. However, the sheer volume of tweets didn't seem to sway voting patterns, and the amount of campaign expenditure was only faintly consequential.

Lassen and Brown (2011) explored Twitter engagement trends among U.S. Congress representatives. Their findings revealed that those from the opposition, the younger brigade, or Senate members were more Twitter-active, particularly if nudged by their party's leadership. Conversely, Hong and Nadler (2011) assessed the potential ripple effects of Twitter engagement by U.S. politicians on public sentiment, but couldn't pinpoint any substantial positive or negative shifts.

When Tumasjan et al. (2011) sifted through tweets during Germany's 2009 federal elections, they recognized Twitter as a pivotal tool for circulating political intel, with party mentions resonating with actual electoral outcomes. Furthermore, an analysis by

Conover et al. (2011) during the U.S. midterm elections in 2010 depicted a distinct divide in the political retweet realm, while user interactions showcased a broader, ideologically mixed engagement. Lastly, Yardi and Boyd (2010) unearthed that while Twitter aficionados commonly engaged with like-minded peers, they didn't shy away from discordant exchanges either. Such interactions either solidified communal bonds or highlighted ideological divides. Cumulatively, these insights underscore Twitter's evolving role in political dialogues, although its influence is shaped by various nuances.
Recent research has demonstrated the significance of social media as a vital political communication tool that facilitates direct interaction between political institutions and voters. This enhances transparency in political activities and encourages citizens' participation in decision-making processes. However, despite these advantages, the full potential of political discussions involving political institutions on social media remains largely unexploited. One possible explanation for this is that politicians lack adequate knowledge about the prevalent issues and debates on various social media platforms (Stieglitz and Dang-Xuan, 2013b).

This study analyzed the impact of sentiment (positive or negative emotion) on the retweet behavior of political tweets on Twitter based on two data sets of more than 165,000 tweets. The researchers found that emotionally charged tweets are more likely to be disseminated compared to neutral ones, and that sentiment is positively related to both retweet quantity and retweet speed. This suggests that sentiment in social media content induces cognitive and arousal-related effects that affect sharing behavior. However, the study found no evidence for the negativity bias theory, which suggests that negative content is more likely to be shared than positive content. The study also found that influential users in the Twitter network tend to post more emotionally charged tweets and expose their content to others by hashtag reference, especially to users with different political alignments (Stieglitz and Dang-Xuan, 2013a).

This table offers a consolidated summary of pivotal studies exploring the use of Twitter within political communication. Highlighting each study's primary focus, essential findings, and the research methodologies employed, it serves as a valuable reference. Through this snapshot, readers can quickly comprehend how Twitter's role in various

political contexts and campaigns has been evaluated and understood across diverse research efforts.

Table 3 : Twitter's role in political communication

Author & Year	**Title**	**Point of the Article**	**Basic Findings**	**Research Method**
Golbeck et al. (2010)	Twitter use by the U.S. Congress	Analyzing tweets from members of US Congress	Twitter primarily used for self-promotion by Congress members; focus on sharing personal daily activities and news articles about themselves.	Primary search
Yardi and Boyd (2010)	An Analysis of Group Polarization Over Time on Twitter	Examining interactions among Twitter users with different political views	Twitter users more likely to interact with like-minded individuals; interactions between different-minded individuals reinforced in-group and out-group affiliations.	Primary search
Ammann (2010)	Why do they tweet? The use of Twitter by US Senate candidates in 2010	Use of Twitter by US Senate candidates during 2010 midterm elections	Use of Twitter varies based on candidate resources, state size, and competitiveness; additional tweets associated with	Primary search

			0.02% increase in voter turnout, but not with vote share.	
Lassen and Brown (2011)	Twitter: The Electoral Connection?	Twitter adoption and use by US Congress members	Members more likely to use Twitter if they are in the minority party, if encouraged by party leaders, if they are young, or if they serve in the Senate.	Primary search
Hong and Nadler (2011)	Does the early bird move the polls? The use of the social media tool 'Twitter' by U.S. politicians and its impact on public opinion	Impact of Twitter use by American politicians on changes in public opinion	Found little evidence that Twitter use by American politicians had a significant positive or negative impact on changes in public opinion.	Primary search
Tumasjan et al. (2011)	Election forecasts with Twitter: How 140 characters reflect the political landscape	Analysis of Twitter messages during the 2009 German federal election	Twitter used extensively for politically relevant information dissemination; number of party mentions on Twitter accurately reflected the election result.	Primary search

Conover et al. (2011)	Political Polarization on Twitter	Examination of networks of political communication on Twitter during the 2010 US elections	Political retweets exhibited a highly segregated partisan structure; user-to-user mention network was dominated by a single politically heterogeneous cluster where ideologically opposed individuals interacted at a higher rate.	Primary search
Larsson and Moe (2011)	Studying political microblogging: Twitter users in the 2010 Swedish election campaign	Examining political use of blogs and Twitter	Twitter used mainly for undirected messages; limited use for conversation and dissemination; major political actors struggle with reciprocal conversations on Twitter; Twitter use concentrated among a minority of users.	Primary search
Stieglitz and Dang-	An Empirical Analysis of Sentiment in	Impact of sentiment on retweet	Emotionally charged tweets are more likely to be	Primary search

Xuan (2013)	Twitter Messages and Retweet Behavior	behavior of political tweets	disseminated compared to neutral ones. Sentiment is positively related to both retweet quantity and speed, but no evidence for the negativity bias theory.	
Jungherr et al. (2016)	The Mediation of Politics through Twitter: An Analysis of Messages posted during the Campaign for the German Federal Election 2013	Analyzing mediation processes in political communication through Twitter	Twitter offers a mediated image of political reality; spikes in Twitter activity align with political/media events but may miss other important events; Twitter data may not always reflect true political reality.	Primary search

2.1.4 Twitter's role in marketing and advertising

In the ever-evolving digital landscape, social media platforms have emerged as powerful tools for communication, connection, and commerce. Among these platforms, Twitter stands out as a unique and influential player in the marketing and advertising realm. With its real-time, concise messaging format, Twitter has become a crucial part of the marketing strategy for businesses across the globe. It enables companies to engage with consumers in novel ways, offering both challenges and opportunities for advertisers and marketers. This chapter explores the multifaceted role of Twitter in marketing and

advertising. We delve into the strategic ways in which businesses leverage Twitter to achieve various marketing objectives, from brand awareness and engagement to customer support and sales generation. Beyond its functionality as a tool for businesses, Twitter also serves as a space where consumers can interact with brands—sometimes becoming brand advocates or critics. First, we discuss the two-fold benefits of social media marketing with a focus on Twitter: cost reduction and revenue generation. We examine how businesses are utilizing Twitter to share insights, engage with prospects, and encourage consumer-to-consumer interactions. We delve into the strategic and methodical approaches that businesses adopt to create a lasting impact through their Twitter presence. The chapter then shifts its focus to various empirical studies conducted in different contexts and cultures, offering a comprehensive view of Twitter's role in marketing and advertising. These studies range from examining the impact of trust in Twitter and celebrity endorsements to the effectiveness of Twitter advertising among specific demographic groups, such as Mexican Millennials. We also consider important issues related to Twitter marketing, such as compliance with age restrictions in sensitive industries like alcohol marketing. Social media offers two key benefits for businesses: cost reduction by minimizing staff time and increasing the likelihood of generating revenue. By leveraging social media, companies can share their knowledge and expertise, tap into the collective wisdom of their consumers, and encourage customers to help one another. Additionally, social media marketing enables businesses to engage with prospects through customer evangelism, and can lead to increased brand reach, consumer interactions, referrals, and reputation management (Durgam, 2015).

Social media marketing is the practice of using online communities, social networks, blog marketing, and other digital channels to persuade consumers that a company's products or services are valuable.To be effective, social media marketing requires a strategic and methodical approach that aims to establish a company's influence, reputation, and brand within potential customer communities, readers, or supporters. This involves much more than simply aiming to get featured on the front page of social news websites. Social media marketing can provide numerous benefits for businesses, such as creating greater visibility and exposure, driving more traffic and subscribers to a website, fostering new business partnerships, improving search engine rankings, generating high-

quality leads through improved lead generation efforts, increasing sales of products and services, and ultimately reducing overall marketing expenses. (Durgam, 2015).

Blogs typically share detailed stories, while microblogs focus on sharing headlines and real-time information. Twitter, a popular microblogging service, defines itself as a real-time information network. Although microblogs are useful for quick reminders, they can also be used to provide valuable links, direct traffic, and enhance a brand's credibility and reputation. Brands can post their own links, but to increase engagement, they must encourage others to retweet their messages through social media optimization strategies. This may involve providing valuable content that followers wish to share or offering incentives to share links.

Pentina et al. (2013) explored how trust in Twitter influences users' desire to remain on the platform and their inclination to engage with brands present there. The research delved into the idea that if users perceive a personality alignment between themselves and Twitter, it can bolster their trust in the platform. By analyzing both American and Ukrainian samples, the study aimed to pinpoint any cultural variances in brand perception and trust. The findings revealed that for both cultures, having trust in Twitter positively impacts their likelihood to continue using it. However, only in the Ukrainian context did trust significantly propel users to interact with brands on Twitter, highlighting potential cultural nuances in the way trust operates. The study underscored the idea that a user's perceived personality alignment with Twitter can indeed foster trust in the platform. Interestingly, distinct personality aspects play a role in cultivating this trust, varying by culture, offering valuable takeaways for international marketing strategies. This research not only deepens our understanding of online user behavior but also offers pivotal guidance for marketing professionals (Pentina et al., 2013, p. 4).

Jin and Phua's 2014 study explored how celebrity endorsements on Twitter shape consumer perceptions and intentions toward brands and products. They conducted two experiments analyzing factors like follower count, tweet sentiment, and celebrity reputation (prosocial vs. antisocial) and their impacts on credibility, social connection, product engagement, and purchase intent. In the first experiment, celebrities with larger followings were seen as more credible. A celebrity with many followers was viewed as

more appealing, trustworthy, and skilled. This increased credibility also made users more inclined to form an online bond with them. Notably, positive tweets from popular celebrities enhanced product interest and buying intentions. Conversely, those with fewer followers didn't see significant shifts in consumer behavior based on tweet sentiment. However, negative tweets from less-followed celebrities prompted users to share negative word-of-mouth more. The second experiment, which focused on a single product type and controlled for celebrity reputation and gender dynamics, found that prosocial celebrities were regarded more favorably. When a well-followed, prosocial celebrity was featured, consumers felt a stronger kinship with them. Crucially, this bond was found to be the bridge between the nature of the celebrity and the likelihood of a purchase, especially after positive brand tweets. These results highlight the potent mix of celebrities with a significant following and a positive public image in influencing Twitter-based brand perceptions. While celebrities on Twitter are seen as peers, they're also regarded as more credible than average users. Their endorsements can amplify brand messages, especially if they have built genuine trust with their audience. Brands should be discerning when picking celebrity endorsers, ensuring their authenticity isn't in question (Jin and Phua, 2014).

In a study by Barry et al. (2016), the accessibility of alcohol marketing to young users on Twitter and Instagram was assessed. By setting up ten fake accounts on each platform with ages between 13 and 21, they tracked interactions with 22 alcohol brands over a month. Results indicated that while Twitter's age-check mechanism hindered underage accounts from following and getting marketing content, all accounts freely interacted with alcohol promotional material on both sites. Specifically, on Instagram, each account followed alcohol brands and received roughly 362 ads in 30 days, with promotional activity surging on Thursdays and Fridays. The research deduced that alcohol brands aren't upholding their self-imposed digital marketing rules, especially on Instagram. It was also observed that alcohol brand representatives on Instagram directly engaged with comments from young users. In essence, the research highlighted that underage individuals are consistently exposed to alcohol promotional content on their mobile devices (Barry et al., 2016).

This passage by Murillo et al., 2016 summarizes a research study that aimed to measure the perceived advertising value of Twitter ads among Mexican Millennials. The study collected data from 630 university students through an online survey and used Partial Least Squares to estimate the model. The study found that informativeness, entertainment, and credibility significantly influenced perceptions of advertising value and attitudes toward advertising on Twitter. Informativeness was the most important factor, followed by entertainment, and credibility. Irritation was the weakest predictor of advertising value and was only significant among certain groups. The study suggests that effective Promoted Tweets should provide relevant and timely product/service information and that personalization of messages could enhance informativeness. It also suggests that writing witty, funny, or entertaining promoted tweets positively influences users' assessment of Twitter ads and their general attitude toward Twitter advertising. These insights could be useful for brands and businesses advertising to Mexican Millennials (Murillo et al., 2016).

Pike JR et al. analyzed Twitter conversations related to e-cigarettes from 2008 to 2013 to understand marketing strategies and common places of e-cigarette usage. The analysis revealed a significant surge in e-cigarette-related tweets, particularly advertisements, with a tenfold increase observed between 2009 and 2010. Those frequently tweeting on this topic included e-cigarette brands, affiliate promoters, and product resellers. When locations were specified in tweets, the most common places for e-cigarette usage included classrooms, homes, public areas, restrooms, and workplaces. The research underscores the prevalent promotion of e-cigarettes on Twitter by various players and the public spaces, including educational institutions, where they are used. This points to the importance of strengthening public awareness and implementing policies that restrict e-cigarette usage in public spaces. The findings also indicate that Twitter analytics can offer valuable perspectives on e-cigarette trends, supporting future research, regulatory actions, and policy enforcement.

This section presents an in-depth examination of various studies that explore Twitter's multifaceted role in marketing, advertising, and consumer behavior. By investigating different facets such as trust, celebrity endorsements, and brand compliance with age restrictions, these studies offer insights into the dynamics of Twitter-based

communication. The table below provides a concise summary of these key studies, capturing their primary focus, findings, and methodologies for quick reference and comprehension.

Table 4 : Twitter's role in marketing and advertising

Author & Year	**Title**	**Point of the Article**	**Basic Findings**	**Research Method**
Pentina et al. (2013)	Antecedents and consequences of trust in a social media brand: A cross-cultural study of Twitter.	Examine impact of trust in Twitter on users' intentions	Trust in Twitter affects users' intentions differently across cultures. Personality match plays a role in trust.	Primary search
Jin and Phua (2014)	Following Celebrities' Tweets About Brands: The Impact of Twitter-Based Electronic Word-of-Mouth on Consumers' Source Credibility Perception, Buying Intention, and Social Identification With Celebrities	Investigate the effects of celebrity endorsements on consumer behavior on Twitter	Number of followers & tweet valence significant. Prosocial celebs are more effective endorsers. Social identification is a mediator.	Primary search
Barry et al. (2016)	Alcohol Marketing on Twitter and Instagram: Evidence of Directly Advertising to Youth/Adolescents.	Investigate alcohol marketing restrictions for young people on social media	Age-gate on Twitter is effective, but underage users can interact with alcohol content on Instagram freely.	Primary search
Murillo	The advertising value	Measure the	Informativeness,	Primary

et al. (2016)	of Twitter Ads: a study among Mexican Millennials	perceived advertising value of Twitter ads among Mexican Millennials	entertainment, and credibility are significant. Irritation was the weakest predictor.	search
Pike JR et al. (2019)	The Effect of E-cigarette Commercials on Youth Smoking: A Prospective Study	Analyze Twitter posts about e-cigarettes	Majority of e-cigarette tweets were ads. E-cigarettes are being promoted by various entities and used in public places.	Primary search

2.2 Recent studies on the use of Twitter / X nowadays

In 2021, amidst the tumultuous backdrop of the U.S. Capitol riots, Twitter decisively banned Trump due to remarks deemed as potential triggers for further violence. Trump countered by accusing Twitter of conspiring with left-wing groups to mute him. Soon after, Jack Dorsey resigned unexpectedly as Twitter's CEO, paving the way for Parag Agrawal, the CTO, to step in. By 2022, Elon Musk, the iconic Tesla CEO, acquired Twitter following a contentious legal battle. Initially hesitant about the $44 billion purchase, Musk eventually committed. Marking his takeover, he whimsically entered Twitter's headquarters with an unusual ceramic sink, captioning the moment humorously on the platform. Swift changes followed, with Musk dismissing Agrawal, as well as other key executives, signaling a new direction for the company (Vanian, 2022).

Elon Musk who has control of Twitter and rebranded it as "X" and it experienced a plethora of fundamental alterations. The impetus for Musk's acquisition is rooted in concerns regarding perceived censorship and an aspiration to cultivate a space for civil

discourse. A series of pivotal changes have already been implemented under his stewardship. The platform's verification mechanism has been overhauled through a subscription service termed "Twitter Blue," aimed at democratizing the verification process. This initiative has engendered considerable controversy and has even drawn the scrutiny of political figures, such as U.S. Representative Alexandria Ocasio-Cortez. A new feature dubbed "X Premium" has been introduced, offering a suite of benefits including early access to innovative features, the ability to edit tweets, a reduction in advertising exposure, and an extension of character limits to 25,000. Critics argue that such extended character counts contravene Twitter's foundational philosophy of concise communication. Conversely, proponents contend that this alteration provides an avenue for more nuanced dialogue (Bullas, 2023).

As the digital landscape continually evolves, so too does the role of platforms like Twitter within it. Once a mere microblogging site, recent research reveals Twitter as a critical hub in the modern information ecosystem, instrumental not only in day-to-day communication but also in shaping global events and narratives. This chapter delves into the current academic discourse on Twitter, highlighting its transformation as a potent conduit for news distribution, a nexus for social connectivity and community formation, a barometer for public sentiment, and a crucial tool in crisis communication and emergency responsiveness. Through this exploration, we aim to capture the multifaceted significance of Twitter in today's interconnected world.

2.2.1 Twitter's role in news dissemination and information sharing

In today's digital age, Twitter has emerged as a prominent platform for information sharing, providing users with the capability to disseminate news and opinions to vast networks in real-time. However, the ease with which information spreads on this platform has also rendered it a fertile ground for the proliferation of fake news, which can shape public opinion, influence political outcomes, and foment discord. Understanding the dynamics of how news, both real and fake, is shared on Twitter is essential to comprehending its broader societal implications, and is crucial in devising strategies to mitigate the spread of misinformation.

In a study by Osmundsen et al (2021) that analyzed the sharing of news on Twitter, it was found that news sharing accounted for a small portion of the overall activity on the platform. Out of 2.7 million tweets examined, only around 3% contained links to national news websites, both real and fake. Among the tweeted news links, approximately 4% originated from websites known for publishing fake news, with a majority of these stories (2,563) coming from pro-Republican fake news publishers. In comparison, there were over twice as many real news stories from pro-Democratic sources (60%) compared to pro-Republican sources (23%). These findings suggest that exposure to fake news is heavily influenced by the ideological leanings of one's Twitter network. While these overall numbers indicate the potential prevalence of fake news sharing within certain social networks, they also reveal significant variations in sharing behavior. A small segment of the population, comprising 1% of the participants, was responsible for sharing approximately 75% of all links to fake news publishers, whereas the top 1% of real news sharers accounted for around 30% of all real news sources. Similar patterns were observed when considering the partisan slant of the news sources. Notably, not all fake news sources are equally concerning. The study categorized fake news sources based on the extent of fabricated stories they published. Around 30% of the fake news links came from sources that predominantly published fabricated stories ("black" sites), while 5% came from sites that spread falsehoods resulting from a flawed editorial process ("red" sites). The remaining two-thirds referred to sources where the falsehoods were less certain to stem from a systematically flawed process ("orange" sites). Although the number of individual stories containing blatant falsehoods may be smaller than the total fake news links identified, sharing news stories from websites with a history of disseminating falsehoods can still be problematic. The study suggests that individuals who share news from these sources often lack knowledge or disregard concerns about the truthfulness of the information. Due to limited fact-checking penetration, sharers typically rely on the reputation of the news source and make informed guesses about the veracity of a news story before deciding to share it. This indicates either ignorance or a lack of concern about the accuracy of the news being shared. The findings suggest that older adults were more likely to share fake news than younger adults, but this cannot be solely attributed to ignorance. Measures of ignorance, such as cognitive reflection, political knowledge, and digital media literacy, did not consistently correlate with fake news sharing. Instead, goal-oriented motivations, particularly partisan goals, played a

significant role. Individuals who identified politically with a specific side were more likely to share stories from sources aligned with their political beliefs. The research implies that interventions to counter fake news should consider the underlying motivations behind sharing behavior. Fact-checking alone may not effectively reduce sharing, as people are primarily concerned with stories that can harm their political enemies. Additionally, addressing the larger issue of political polarization is crucial for combating fake news. While interventions can decrease the sharing of fake news, the selective engagement with derogatory news stories remains a concern, regardless of their truthfulness (Osmundsen et al., 2021).

This study by Murayama et al. (2021) proposes a mathematical model to understand the dissemination of fake news on Twitter. The model describes the spread of fake news as a two-stage process: initially, it spreads as ordinary news, and then users start recognizing its falsity, leading to the spread of the revelation itself. The researchers validate the model using two datasets of fake news on Twitter and show that it outperforms existing methods in predicting the spread of fake news accurately. The model also helps determine the correction time when users realize the news is false. The findings contribute to understanding the dynamics of fake news on social media and can aid in detecting and mitigating its impact. Future research directions include exploring cascades with multiple bursts, extending the model's complexity, and applying it to practical problems like fake news detection and mitigation. Overall, the proposed model provides valuable insights into the spread of fake news and enables a compact representation of temporal information related to its dissemination (Murayama et al., 2021).

In summary, this study focused on using social network analysis and sentiment analysis to understand knowledge sharing and opinion leaders in construction safety-related Twitter networks. The researchers analyzed three networks: "construction safety," "construction health," and "construction accident." They found low network density and limited interaction among users, indicating a lack of interest in construction safety topics. The top opinion leader identified was the Construction Industry Federation (cif_ireland), an organization representing the Irish construction industry. However, sentiment analysis showed that sentiment valence had no correlation with favorites or retweets, although there was a positive correlation between favorites and retweets. The study highlighted the

need for opinion leaders to actively engage with users, encourage interaction, and consider individual differences in language and content to enhance knowledge sharing and improve construction safety. The researchers emphasized the untapped potential of Twitter as a platform for disseminating construction safety information and stimulating interest among the public (Yao et al., 2021) .

Twitter, in the digital era, has become a primary channel for information dissemination, particularly news. However, the implications of this widespread information sharing, especially when fake news is involved, raise concerns. Numerous studies have delved into understanding the patterns, motivations, and dynamics of news sharing on Twitter. The following table summarizes key findings from three such studies, offering insights into how news, both authentic and fabricated, is distributed and consumed on this platform.

Table 5 : Twitter's role in news dissemination and information sharing

Author & Year	**Title**	**Point of Article**	**Basic Findings**	**Research Method**
Osmundsen et al. (2021)	Partisan Polarization Is the Primary Psychological Motivation behind Political Fake News Sharing on Twitter	Understanding how news, real and fake, is shared on Twitter and its broader societal implications	A small portion of Twitter users share the majority of fake news. Older adults more likely to share fake news.	Primary search
Murayama et al. (2021)	Modeling the spread of fake news on Twitter	Proposing a mathematical model to understand the dissemination of fake news on Twitter	The model accurately predicts the spread of fake news and helps determine when users realize the	Primary search

			news is false.	
Yao et al. (2021)	Construction safety knowledge sharing on Twitter: A social network analysis	Understanding knowledge sharing and opinion leaders in construction safety-related Twitter networks	Low network density and limited interaction among users in construction safety topics.	Primary search

2.2.2 Twitter as a platform for social interactions and community building

As one of the world's most influential social media platforms, Twitter has evolved far beyond its initial design as a simple microblogging service. Today, it serves as a complex social ecosystem where people form connections, engage in discussions, and build communities based on shared interests or affiliations. While Twitter enables global conversations and empowers voices that might otherwise go unheard, it also poses significant challenges, such as the formation of echo chambers due to shared political partisanship, and the rise of antisocial behaviors such as cyberbullying and trolling. Understanding these dynamics is critical, not just for the platform's users, but for society at large, given Twitter's significant role in shaping public discourse.

A study conducted by Mosleh et al. (2021) explored the influence of shared political partisanship on the formation of social ties, specifically on Twitter. The researchers set up a field experiment where they created bot accounts that self-identified as either Democratic or Republican and varied the strength of that identification. These bot accounts were then used to follow 842 Twitter users. Their findings show that Twitter users were about three times more likely to follow back bots that shared their political affiliation. This finding remained consistent irrespective of the bot's degree of partisanship. The study also found no significant difference between Democrats and Republicans in terms of preferential follow-back behavior, challenging the argument that conservatives tend to be more homophilous on Twitter. In essence, shared political partisanship was found to have a strong causal effect on the formation of social ties on

Twitter. These results have significant implications for understanding social media dynamics and echo chambers, which refers to situations where like-minded individuals predominantly share information with those holding similar worldviews. It suggests that if we want to reduce partisan assortment on social media, algorithms may need to counteract pre-existing psychological biases. The findings also add to the understanding of the polarization of the American public, a topic that is highly relevant in today's political and social climate. In terms of community building, the study sheds light on how shared partisanship can drive social tie formation in online spaces, potentially leading to the creation of homogenous online communities. It also raises questions about how algorithms could promote more diverse interactions, thus fostering more varied and inclusive online communities. However, the researchers noted that their findings are specific to politically active Twitter users and further research is needed to see if these results generalize to more representative samples (Mosleh et al., 2021).

Recently, online professional learning networks, particularly on Twitter, have become increasingly relevant due to their capacity for immediacy, personalization, and fostering community support. These attributes significantly contribute to enhancing professional knowledge and building a sense of belonging among users. The present study's focus was the exploration and analysis of topics discussed on Twitter, specifically within the Virtual Professional Learning Network (VPLN) using the #Edchat hashtag over six years. Furthermore, the study aimed to understand factors that impact the sustainability of these topics, underpinning the idea of constructing and strengthening Twitter-based professional communities. To achieve this, the study utilized a combination of internet-mediated research, digital data collection techniques, text analysis, natural language processing, machine learning algorithms, and quantitative multilevel models. With an extensive dataset of 504,998 tweets from 72,342 unique users who used #Edchat, the study found that there were 150 distinct topics over six years. The results revealed that the duration of a topic's discussion within the #Edchat community is extended when there are more original tweets (as opposed to retweets) from a broad range of users, along with moderate text length, and an increased frequency of mentions and hashtags. From these findings, an automated social media richness feature extraction framework was created to foster community building and professional development discussions among the #Edchat VPLN members. This study contributes to extending the social media richness theory in

an educational context and provides a deeper understanding of factors shaping the dynamics of professional community-building activities on Twitter (Arslan et al., 2022) . Online environments have, over time, become crucial platforms for social interaction. However, with the proliferation of these digital platforms, there's been an unfortunate rise in antisocial behaviors like cyberbullying, trolling, and hate speech, especially on popular social media platforms like Twitter. Such behaviors have negative implications for user experiences and community building. Therefore, the automatic detection of aggressive behavior online has become increasingly important. In this extensive study, the authors seek to address this pressing issue, focusing their efforts on Twitter as their primary platform. The aim is to create an effective and efficient system to automatically detect aggression in tweets, thus helping to limit the negative impact of such behavior on the community and foster a more positive, supportive, and constructive online environment. Saima Sadiq et al. (2021) utilized a cyber-troll dataset to train various machine learning models, including a Multilayer Perceptron (MLP), and deep learning architectures such as Convolutional Neural Network - Long Short Term Memory (CNN-LSTM) and Convolutional Neural Network - Bidirectional Long Short Term Memory (CNN-BiLSTM). The goal was to see how well these models could classify tweets as being aggressive or non-aggressive. Their approach was innovative, making use of Term Frequency – Inverse Document Frequency (TF-IDF) to extract important features from the tweets. These features were then fed into the MLP model. The proposed method demonstrated impressive results, achieving a 92% accuracy in detecting aggressive behavior in tweets. Additionally, the MLP model, due to its streamlined architecture, improved the efficiency of training time – a significant factor considering the massive volumes of data that platforms like Twitter generate. However, like all models, it had its limitations. The study found that this MLP model had a harder time detecting aggression in shorter tweets or in those where there were fewer harsh words. Despite its high accuracy overall, this indicates a need for further optimization to better handle a wider range of aggressive behavior online. Looking to the future, the authors propose several enhancements to this model. They suggest exploring different features and combinations of features to improve the model's performance in detecting aggression in a wider variety of cases. They also mention the possibility of feature fusion as a method to further enhance the model's performance. This research offers a significant contribution to our understanding of how to improve discourse within the Twitter community and other

social media platforms. By effectively detecting and managing aggression, such a system can foster healthier and more productive interactions online, leading to stronger and more cohesive online communities. It also helps to underline the importance of ongoing research and technological advancement in promoting safer and more respectful digital interactions (Saima Sadiq et al, 2021).

Understanding the multifaceted dynamics of Twitter as a platform for social interactions and community building is crucial in today's digital age. The following table presents an overview of three seminal studies that delve into diverse aspects of Twitter, ranging from the influence of political partisanship on social ties, the evolution of professional learning networks, to aggression detection.

Table 6 : Twitter as a platform for social interactions and community building

Author & Year	**Title**	**Point of Article**	**Basic Findings**	**Research Method**
Mosleh et al. (2021)	Shared partisanship dramatically increases social tie formation in a Twitter field experiment	Influence of shared political partisanship on social ties on Twitter	Users are three times more likely to follow back bots that share their political affiliation.	Primary search
Saima Sadiq et al. (2021)	Aggression Detection Through Deep Neural Model on Twitter	Creating a system to automatically detect aggression in tweets	Achieved a 92% accuracy in detecting aggressive behavior in tweets using an MLP model.	Primary search
Arslan et al. (2022)	Understanding topic duration in Twitter learning communities using	Analysis of topics discussed within the Virtual Professional	150 distinct topics found over six years within the	Primary search

	data mining	Learning Network on Twitter	#Edchat community.	

2.2.3 Twitter's impact on public opinion and sentiment analysis

In an age where social media platforms have emerged as powerful tools for communication and information dissemination, understanding public sentiment on critical issues has never been more accessible or substantial. Twitter, a platform known for its real-time, microblogging format, has become a significant player in this arena. In the context of the COVID-19 pandemic, Twitter has provided a window into the shifting landscape of public opinion and sentiment on pivotal matters such as vaccines, social distancing measures, and policy reactions to the virus's spread. With millions of users globally, Twitter's platform captures a diverse range of voices, making it an invaluable data source for gauging public sentiment and emotion. This chapter delves into various studies that have harnessed Twitter data to analyze public sentiment on critical topics related to the COVID-19 pandemic, as well as other areas such as cryptocurrency and financial indices. These studies employ an array of methodologies, from machine learning and natural language processing algorithms to lexicon sentiment analysis, to explore and dissect the emotions and opinions embedded within tweets.

The study by Hu T et al. (2021) aimed to investigate public opinion and perception of COVID-19 vaccines in the United States by analyzing spatiotemporal trends of sentiment and emotion found in geotagged tweets. The findings indicate that critical events or announcements by political leaders and authorities had potential impacts on public opinion towards COVID-19 vaccines. For example, events such as vaccine-related conspiracy theories, positive tweets by Donald Trump, statements by Kamala Harris, Biden's victory in the presidential election, and the authorized usage of Pfizer and Moderna vaccines affected public sentiment. Three distinct phases were identified over the study timeframe, showing varied changes in public opinions across space and time. Generally, an increase in positive sentiment and a decrease in negative sentiment were observed in most states, reflecting rising confidence and anticipation towards COVID-19 vaccines. Emotion analysis revealed a mixture of trust, anticipation, fear, sadness, and

anger among the public. The study highlights the importance of monitoring public sentiment through real-time social media data, particularly on platforms like Twitter. Analyzing public attitudes towards vaccine-related information in a geo-aware and timely manner can benefit public health authorities in addressing vaccine skeptics' concerns and promoting confidence within specific regions or communities. The findings emphasize the role of public figures, especially politicians, in shaping public opinions on vaccination, underscoring the need for cautious and accurate communication from these figures. The study also reveals the impact of vaccine-adverse conspiracy theories on sentiment scores, emphasizing the challenge of misinformation dissemination through social media. Government officials can leverage social media platforms to directly communicate with individuals and address region-specific concerns. The study recognizes the limitations of Twitter data, such as its demographic biases and limited representativeness. Future research could explore alternative data sources to complement Twitter data and provide a more comprehensive understanding of public opinions towards COVID-19 vaccines. Additionally, efforts can be made to increase the sample size, account for variations in sentiment throughout the day, and examine emotions in greater detail. The study suggests extending the analysis to different phases of the pandemic, including the recovery phase and the post-pandemic years, to capture evolving sentiments and perspectives. Applying the study's methodology to analyze global-scale geotagged tweets in multiple languages could further enhance understanding of vaccination's impact across countries. Analyzing Twitter data provides valuable insights into public opinions and perceptions of COVID-19 vaccines. Monitoring sentiment and emotion trends on social media platforms enables timely intervention and informed decision-making for public health authorities. However, the study acknowledges the limitations of Twitter data and recommends further research to address these limitations and expand the analysis to a global scale (Hu T et al, 2021).

This study by Shofiya and Abidi (2021) aimed to analyze public sentiments towards social distancing using Twitter data in Canada during the COVID-19 pandemic. A total of 629 tweets were analyzed, with 40% expressing neutral sentiments, 35% negative sentiments, and only 25% positive sentiments towards social distancing. The Support Vector Machine (SVM) algorithm was used for sentiment classification, achieving an accuracy of 71% when all sentiment polarities were considered. However, when only

positive and negative sentiments were used, the accuracy increased to 81%. Increasing the training data with positive and negative sentiments further improved the accuracy to 87%. Manual annotation of tweets provided insights into public concerns and sentiments related to the pandemic. The study highlighted the potential of Twitter as a knowledge translation tool for disseminating information and promoting positive messaging. Public health authorities can utilize Twitter to monitor negative sentiments and deliver targeted information to individuals experiencing extreme negativity. The findings can aid policymakers in assessing compliance with preventive measures and making necessary changes to encourage adherence. The study emphasized the value of combining manual annotation, sentiment analysis tools like SentiStrength, and machine learning algorithms like SVM for better understanding of Twitter data. The dataset also provides opportunities for predictive and geospatial analytics. Overall, Twitter analysis offers valuable insights into public sentiments towards social distancing during the pandemic, enabling evidence-based decision-making for public health authorities (Shofiya and Abidi, 2021).

This paper by (Hassan et al., 2022) explores netizens' opinions on cryptocurrency using emotion theory and lexicon sentiment analysis through machine learning. The researchers collected data from 15,000 tweets on cryptocurrency using web scraping with RStudio. They applied machine learning techniques to perform sentiment lexicon analysis and evaluate the emotion scores of the sample. The emotions tested included anger, anticipation, disgust, fear, joy, sadness, surprise, trust, and the primary sentiments of negative and positive. The findings show that the sampled tweets contained a total of 53,077 sentiments. The dominant emotions were positive (33%), anticipation (18%), joy (15%), and trust (15%). The other emotions, such as anger, disgust, fear, sadness, surprise, and negative sentiment, had lower scores ranging from 1% to 4%. These results indicate that the overall sentiment towards cryptocurrency in the sample was positive. The study suggests that the positive sentiment may reflect the increased investment in the decentralized finance market, while anticipation emotion may relate to public reactions towards the bubble prices of cryptocurrencies. The research highlights the importance of sentiment analysis in understanding the social implications of the cryptocurrency phenomenon, particularly in terms of price movements and public opinions (Hassan et al., 2022).

This study by Naseem et al. (2021) examines the sentiment and public opinion surrounding COVID-19 on Twitter. The researchers collected a large-scale dataset of 90,000 COVID-19-related tweets from February to March 2020 and labeled them into positive, negative, and neutral sentiment classes. Various machine learning (ML) and deep learning (DL) classifiers were employed to analyze the sentiment. The results showed that negative opinions played a significant role in shaping public sentiment, with initial support for lockdown measures shifting over time. The study emphasizes the need for a proactive and agile public health presence to counter the spread of negative sentiment and misinformation on social media during a pandemic. Different ML and DL models were evaluated, with the BERT transformer-based model outperforming other methods in capturing contextual word representation. The research provides valuable insights into the evolving public sentiment on Twitter and highlights the importance of curbing misinformation through policy interventions on social media platforms. The dataset used in the study, called COVIDSENTI, has also been made publicly available for further research in sentiment analysis (Naseem et al., 2021).

This research by Valle-Cruz et al., 2022 investigates the impact of Twitter posts on financial indices during pandemics by conducting financial sentiment analysis. The study analyzes Twitter data from influential financial accounts and its relationship with important financial indices. Fundamental and technical financial analysis, along with a lexicon-based approach, are used to calculate correlations between the polarities of financial market indicators and Twitter posts. The study finds that markets typically react within 0 to 10 days after information is shared on Twitter during the COVID-19 pandemic and within 0 to 15 days during the H1N1 pandemic. An inverse relationship is identified, with Twitter accounts reacting to financial market behavior within a period of 0 to 11 days during the H1N1 pandemic and 0 to 6 days during the COVID-19 pandemic. The research highlights the effectiveness of using SenticNet for detecting correlations, even on the same day as the Twitter posts. The most influential Twitter accounts during the pandemic period include The New York Times, Bloomberg, CNN News, and Investing.com, exhibiting a strong correlation between sentiments on Twitter and stock market behavior. By combining lexicon-based approaches with shifted correlation analysis, hidden correlations can be uncovered, providing valuable insights into the relationship between Twitter sentiment and financial indices (Valle-Cruz et al., 2022).

A sentiment and attitudes towards SARS-CoV-2 vaccination using data from Twitter has conducted by Marcec and Likic. The researchers utilized the Twitter academic API to collect English-language tweets mentioning AstraZeneca/Oxford, Pfizer/BioNTech, and Moderna vaccines over a 4-month period from December 1, 2020, to March 31, 2021. Sentiment analysis was conducted using the AFINN lexicon to calculate the average daily sentiment of the tweets for each vaccine. The findings reveal that the sentiment towards Pfizer and Moderna vaccines remained consistently positive throughout the 4-month period, with no significant variations observed. However, the sentiment regarding the AstraZeneca/Oxford vaccine exhibited a declining trend over time. There was a notable decrease in sentiment from December to March, indicating a shift towards negative sentiment ($p<0.0000000001$, mean difference=−0.746, 95%CI=−0.915 to −0.577). The study concludes that Twitter sentiment analysis, based on lexicon-based methods, serves as a valuable and easily implemented tool for monitoring public sentiment towards SARS-CoV-2 vaccines. Of concern is the observed decline in sentiment specifically related to the AstraZeneca/Oxford vaccine, which may contribute to vaccine hesitancy rates. This highlights the importance of addressing concerns and promoting accurate information to enhance vaccine acceptance and uptake among the population. Twitter serves as a valuable platform for tracking and understanding public attitudes towards vaccination during the ongoing pandemic (Marcec and Likic, 2022) .

This study by Lyu et al. (2021) analyzes public discussion on Twitter regarding COVID-19 vaccines to understand topics and sentiments influencing public perceptions. Researchers collected tweets from a large-scale COVID-19 Twitter dataset from March 11, 2020, to January 31, 2021. They used topic modeling and sentiment analysis to identify 16 topics grouped into 5 themes. Opinions about vaccination were the most discussed topic, and vaccine progress globally gained attention after Russia's vaccine approval. The sentiment was generally positive, with trust being the dominant emotion. The study suggests that Twitter discussions on COVID-19 vaccines reflect major events and media coverage. The positive sentiment and trust observed may indicate higher acceptance compared to previous vaccines. This underscores the importance of addressing concerns and sharing accurate information on social media platforms to foster vaccine acceptance (Lyu et al., 2021).

The power of social media platforms, particularly Twitter, has provided researchers with a dynamic tool to gauge public sentiment on various issues. With the eruption of the COVID-19 pandemic, understanding public perception became even more critical for shaping policies and addressing concerns. The following table encapsulates a series of studies that leveraged Twitter data to examine sentiments surrounding topics such as COVID-19 vaccines, social distancing measures, cryptocurrency, and financial indices during times of crisis.

Table 7 : Twitter's impact on public opinion and sentiment analysis

Author & Year	**Title**	**Point of Article**	**Basic Findings**	**Research Method**
Hu T, et al. (2021)	Revealing Public Opinion Towards COVID-19 Vaccines With Twitter Data in the United States: Spatiotemporal Perspective	Investigate public opinion and perception of COVID-19 vaccines in the US	Varied changes in public opinions influenced by events, increasing positive sentiment overall	Primary search
Shofiya and Abidi (2021)	Sentiment Analysis on COVID-19-Related Social Distancing in Canada Using Twitter Data	Analyze public sentiments towards social distancing in Canada during COVID-19	40% neutral, 35% negative, 25% positive sentiments towards social distancing	Primary search
Lyu et al. (2021)	COVID-19 Vaccine–Related Discussion on Twitter: Topic Modeling and Sentiment Analysis	Analyze public discussion on Twitter regarding COVID-19 vaccines to understand perceptions	Most discussed topic: Opinions about vaccination; generally positive sentiment with trust as dominant emotion	Primary search
Naseem	COVIDSenti: A	Examine	Negative opinions	Primary

et al. (2021)	Large-Scale Benchmark Twitter Data Set for COVID-19 Sentiment Analysis	sentiment and public opinion surrounding COVID-19 on Twitter	played a significant role; initial support for lockdown measures shifted over time	search
Valle-Cruz et al. (2022)	Does Twitter Affect Stock Market Decisions? Financial Sentiment Analysis During Pandemics: A Comparative Study of the H1N1 and the COVID-19 Periods	Investigate the impact of Twitter posts on financial indices during pandemics	Markets react to Twitter info within 0 to 10 days (COVID-19) and 0 to 15 days (H1N1); Twitter reacts to market behavior	Primary search
Marcec and Likic (2022)	Using Twitter for sentiment analysis towards AstraZeneca/Oxford, Pfizer/BioNTech and Moderna COVID-19 vaccines	Explore sentiment and attitudes towards SARS-CoV-2 vaccination using Twitter data	Positive sentiment for Pfizer and Moderna; declining sentiment for AstraZeneca/Oxford	Primary search
Hassan et al. (2022)	Mining netizen's opinion on cryptocurrency: sentiment analysis of Twitter data	Explore netizens' opinions on cryptocurrency	Dominant emotions: Positive (33%), anticipation (18%), joy (15%), and trust (15%)	Primary search

2.2.4 Twitter's role in crisis communication and emergency response

In an increasingly interconnected world, communication during times of crisis is paramount. The advent and widespread adoption of social media platforms, particularly

Twitter, have transformed how information is disseminated and consumed during emergencies. This chapter delves into the multifaceted role that Twitter plays in the context of crisis communication and emergency response, illustrating its significance through various lenses, including public health crises, natural disasters, and geopolitical events. The onset of the COVID-19 pandemic, in particular, provided a unique, large-scale scenario wherein Twitter emerged as a critical tool for public health agencies, government officials, and stakeholders to communicate risk, policies, and safety measures. While Twitter's real-time, wide-reaching capabilities have proved to be vital, this chapter also exposes the inconsistencies and potential shortcomings in the information disseminated through this platform, which sometimes led to public confusion and misinterpretation of crucial information. Through an examination of different crises, including natural disasters like earthquakes and hurricanes, as well as man-made crises such as chemical attacks, this chapter illustrates how Twitter is utilized by various actors—including individual citizens, governmental bodies, and international organizations—to share news, coordinate responses, and express sentiments and emotions. We explore the mechanics behind the analysis of Twitter data, employing methods like machine learning algorithms, sentiment analysis, network analysis, and Natural Language Processing (NLP) to extract meaningful patterns and insights. Twitter has played a significant role in specific geopolitical contexts, such as in Indonesia during the management of the COVID-19 pandemic, where the platform facilitated noteworthy interaction and synchronization among government officials. Moving beyond the context of public health, we also consider the use of Twitter during natural hazards, using Hurricane Harvey as a case study to demonstrate Twitter's capability as a tool for monitoring and analyzing the behavior of urban communities and its potential in contributing to disaster preparedness and response.

This research paper by Wang et al. (2021) explores the significant role that Twitter played in disseminating information about COVID-19 from public health agencies and governmental stakeholders to the general public. Due to its wide reach and ability to provide real-time updates, Twitter proved essential in risk and crisis communication during the pandemic. The study analyzed 13,598 tweets related to COVID-19 posted from January to April 2020. By identifying and tracking 16 categories of message types, the researchers studied their appearances, evolutions, and the level of congruence and

consistency. Network analysis was also used to understand the level of coordination between different agencies and stakeholders over time. The research findings revealed that Twitter played a critical role during the early stages of COVID-19 by enabling health risk communication. However, it also highlighted significant issues of insufficiency, inconsistency, and incongruency in the messages disseminated, which could have led to public confusion and misinterpretation of information. The frequency and timing of Twitter messages related to COVID-19 were found to vary greatly across U.S. states, with some being more active than others. The types of messages posted and their timing also showed considerable variability, indicating inconsistent risk communication across states. The study also found significant interactions among agencies and stakeholders. Particularly, the Twitter account of the CDC had the highest degree of connectivity. Four closely connected communities of communication were identified, each centered around a key actor: the CDC, the NIH/NIMH/NIAID, the WHO, and a group of state agencies. Over the course of 16 weeks, the dynamics of the communication networks experienced significant change. Initially sparse, the network grew more interconnected as more agencies started posting relevant messages independently. In conclusion, the research underscores the essential role of Twitter in communicating about COVID-19, and highlights the need for more consistent, congruent, and sufficient messaging in order to avoid public confusion and increase adherence to preventative measures (Wang et al., 2021)

This paper by Behl et al. (2021) discusses the use of online social media, specifically Twitter, as a solution for aiding disaster management in emergencies and disasters. The focus is on classifying Twitter data using supervised learning approaches, specifically comparing different approaches for multi-class classification. The goal is to classify tweets into three categories: 'resource needs', 'resource availability', and 'others' (neutral and of no useful information). The study utilizes public datasets from the Nepal Earthquake (2015) and Italy Earthquake (2016) for training and validation of the models. The original COVID-19 dataset is used for testing. The paper includes detailed data analysis of tweets collected during different disasters. The proposed model, which involves the use of a Multilayer Perceptron (MLP) network with carefully set layers and an optimizer, achieves 83% classification accuracy on the original COVID-19 dataset. The paper also incorporates the use of Local Interpretable Model-Agnostic Explanations

(LIME) to explain the behavior and shortcomings of the model on the COVID-19 data. The role of social media, particularly Twitter, is highlighted in disaster situations, including preparation, response, and recovery phases. The paper emphasizes the ability of social media platforms to facilitate real-time information sharing, communication, and coordination among affected individuals, organizations, and communities. The study acknowledges the limitations of the available annotated datasets, as well as the challenge of data imbalance in resource-related tweets. It explores different techniques, such as oversampling and stratified sampling, to address these challenges during the training and testing phases. The results show that deep learning algorithms, particularly the proposed MLP model, outperform traditional machine learning methods in classifying disaster-related tweets. The use of pre-trained disaster-specific word embeddings is found to be more effective than TF-IDF for text vectorization. The paper concludes by highlighting the contributions of the research, including the exploration of utilizing social media in disaster relief operations, the comparison of different supervised classification algorithms, and the application of LIME for model interpretation. The proposed MLP model, trained on previous disasters, is found to be usable for classifying tweets in an unseen disaster. The authors suggest that their research provides a simple choice for real-world applications and serves as a starting point for future research. They emphasize the need for incorporating diverse data and improving the model in future studies (Behl et al., 2021).

The study highlights the significant role of Twitter as a social media platform during natural hazards, specifically focusing on Hurricane Harvey in southeast Texas. Twitter is considered one of the most popular platforms for curating, analyzing, and summarizing crisis-related information. It offers advantages such as real-time communication, instant information dissemination, and global reach. During natural hazards, Twitter becomes a pivotal tool for monitoring and analyzing the behavior of urban communities. People use Twitter to share news and updates about both human-made and natural hazards. The platform enables individuals to communicate real-time information that can reach a wide audience, including city authorities and disaster response managers. The study emphasizes the valuable information shared on Twitter during natural hazards, which is often not available through traditional media channels. Social media data, particularly from Twitter, can serve as a constant stream of content that provides crucial insights for

disaster responders and crisis managers. This information can aid in preventing crises, helping affected individuals, improving situational awareness, and enhancing infrastructure for future catastrophic events. The research proposes a new Hazard Risk Awareness (HRA) Index that considers multiple factors, including the number of tweets, population, internet use rate, and natural hazard characteristics per geographic location. The index is mapped across the affected counties in southeast Texas during Hurricane Harvey. By employing Natural Language Processing (NLP) and statistical techniques, the study categorizes tweet contents into several informative categories per county, which can inform crisis management during the event. The findings of the study provide valuable information at the county level, aiding disaster managers and responders in minimizing the consequences of natural hazards and improving the preparedness of residents. Twitter, with its vast user base and real-time nature, serves as a valuable source of data for monitoring and evaluating risk awareness during disasters. In summary, the study emphasizes the increasing use of Twitter during natural hazards and highlights its role as a crucial platform for sharing information, providing situational updates, and facilitating communication among affected individuals, disaster responders, and crisis managers. The analysis of Twitter data enables the assessment of risk awareness and offers valuable insights for effective emergency response and disaster management (Karimiziarani et al., 2022) .

The purpose of this study by Bashir et al. (2021) was to analyze the sentiment of tweets during and after the Khan Shaykhun Syria Chemical Attack to understand people's attitudes and perceptions towards the event. The study involved downloading and analyzing 13,156 English tweets posted on Twitter during the first 27 days of the attack. The tweets were manually analyzed, and sentiments were categorized into eight broader categories. The findings showed that Twitter was primarily used for sharing news and information about the attack, with 35.71% of the tweets falling into this category. Emotion-evoking tweets accounted for 22.75% of the total, while suggestive tweets constituted 18.74%. Tweets that criticized the government received the highest retweet count, followed by tweets that evoked emotions. Tweets that raised questions and provided suggestions had less impact. Individuals were the largest contributors to the tweets (77.05%), followed by news channels (8.79%) and various organizations (7.22%). Most tweets were in text format (61.27%), followed by text with images (23.84%). The

study also analyzed the geographical distribution of tweets and identified the top tweeting countries with the highest percentage of positive, negative, and neutral sentiments. This study contributes to the existing literature on Twitter and its use during crisis episodes. It highlights the role of Twitter in providing situational awareness and emotional support during a crisis. The findings have implications for news agencies in effectively sharing real-time information and for authorities in understanding public sentiment and framing disaster response strategies. By analyzing the sentiments expressed on Twitter, this study contributes to a better understanding of how social media platforms can be utilized to capture public reactions and inform crisis management efforts. In summary, this study demonstrates the use of Twitter during the Khan Shaykhun Syria Chemical Attack and provides insights into the sentiments expressed by Twitter users. The findings emphasize the importance of Twitter in sharing news, evoking emotions, and facilitating social support during crises. The study also highlights the impact of different types of tweets and the geographical distribution of sentiments. These findings have practical implications for news agencies, authorities, and disaster response efforts. Understanding the role of social media platforms like Twitter in crisis situations can enhance communication, situational awareness, and response strategies (Bashir et al., 2021).

This study by Machmud et al. (2021) focuses on the role of Twitter in facilitating communication and coordination among government officials during the handling of the Covid-19 pandemic in Indonesia. It employs a qualitative content analysis approach to analyze the Twitter accounts of official Indonesian government officials, including President Jokowi, governors, and the official team for Covid-19 management (GT Covid RI). The findings demonstrate a high level of interaction and synchronization among these officials, aiming to accelerate the handling process of the pandemic. President Jokowi plays an active role in initiating and maintaining communication with the GT Covid RI team and several governors. His Twitter content emphasizes the need for unity and collaboration in managing the pandemic, using keywords like "KITA" (we/us). This highlights the shared responsibility and collective effort required from all stakeholders to combat the virus effectively. The GT Covid RI team serves as a reference institution, facilitating communication and coordination among government officials at different

levels. Twitter serves as a platform for government officials to exchange information, share updates, and collaborate on policy implementation. It enables them to disseminate information to the public and engage with citizens. The study reveals that Twitter plays a significant role in enabling communication and coordination among government officials, fostering synergy and accelerating the handling process of the Covid-19 pandemic in Indonesia. The attention and focus of government officials' Twitter content vary, with different actors emphasizing different aspects of the pandemic response. For instance, governors focus on raising public awareness, implementing policies, and fostering cooperation within their respective regions. This variation in attention reflects the specific challenges and priorities faced by different regions and the efforts made by local officials to address them. While Twitter proves to be a valuable platform for communication and coordination, the study acknowledges its limitations as a sole source of data. It emphasizes the need for future research to adopt a triangulation analysis approach, combining data from Twitter with other sources such as online media, official government reports, interviews, surveys, and observations. Such an approach would provide a more comprehensive understanding of the government officials' communication and coordination performance during the Covid-19 pandemic. Overall, this study highlights the important role played by Twitter in enabling communication and coordination among government officials during the handling of the Covid-19 pandemic in Indonesia. The platform facilitates information sharing, collaboration, and the building of synergy among government ranks. Effective communication and coordination are crucial for timely decision-making, policy implementation, and crisis management. While Twitter plays a significant role, future research should adopt a triangulation analysis approach to gain a comprehensive understanding of government officials' communication and coordination efforts during the pandemic (Machmud et al., 2021).

Mohammed and Ferraris (2021) examined the factors that influence active participation on Twitter during a crisis, specifically focusing on the COVID-19 pandemic in Saudi Arabia. The study uses the Theory of Planned Behavior (TPB) as a framework and collects survey data from 213 Twitter users. The data is analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The study finds that attitude, perceived behavioral control, and subjective norms significantly affect Twitter users' active participation during a crisis. Additionally, utilitarian and hedonic values, as well as

trust, have a positive impact on active participation. These factors account for 48.3% of the variance in active Twitter participation. The research has several theoretical implications. It extends the TPB model by including utilitarian and hedonic values and trust as additional factors that influence participation behavior. The study demonstrates the predictive power of the TPB model in the context of social media participation during a crisis. From a practical standpoint, the findings have implications for crisis managers and decision-makers. By understanding the factors that drive active participation on Twitter during a crisis, they can facilitate and encourage such participation, aiding in crisis management. For example, they can invest in information communication technologies and develop informative websites to provide vital crisis-related information. They can also build relationships with opinion leaders who can influence participation and ensure timely and credible information dissemination. In summary, this research provides valuable insights into the factors influencing active participation on Twitter during a crisis, contributing to the understanding of social media behavior in such situations. The findings have implications for crisis management and offer directions for future research (Mohammed and Ferraris, 2021).

Social media platforms, notably Twitter, have become instrumental in disseminating and collecting information during crises and emergencies. Given its real-time nature, Twitter offers a unique vantage point to monitor public sentiments, coordinate emergency responses, and foster communication. Several studies have delved into the multifaceted role of Twitter during various crises, ranging from natural disasters to global pandemics. The following table provides an overview of select research studies that have explored the impact and utility of Twitter in crisis communication and management scenarios.

Table 8 : Twitter's role in crisis communication and emergency response

Author & Year	**Title**	**Point of the Article**	**Basic Findings**	**Research Method**
Wang et al. (2021)	Examining risk and crisis communications of government agencies and	The role Twitter played in disseminating information about COVID-	Twitter played a critical role in health risk communication during the early	Primary search

	stakeholders during early-stages of COVID-19 on Twitter	19 from public health agencies and governmental stakeholders to the general public.	stages of COVID-19, but issues of insufficiency, inconsistency, and incongruency in messages were observed. Variability in message frequency, timing, and types across U.S. states. CDC had highest connectivity in communication network.	
Behl et al. (2021)	Twitter for disaster relief through sentiment analysis for COVID-19	Classifying Twitter data using supervised learning approaches for disaster management. Classification into 'resource needs', 'resource availability', and 'others'.	The proposed MLP model achieved 83% classification accuracy on the original COVID-19 dataset. Pre-trained disaster-specific word embeddings found to be more effective than TF-IDF for text vectorization.	Primary search

Bashir et al. (2021)	Twitter chirps for Syrian people: Sentiment analysis of tweets related to Syria Chemical Attack	Analyzing the sentiment of tweets during and after the Khan Shaykhun Syria Chemical Attack to understand public attitudes and perceptions.	Twitter primarily used for sharing news and information about the attack. Tweets that criticized the government received the highest retweet count. Identified top tweeting countries with varying sentiments.	Primary search
Machmud et al. (2021)	Analysis of the Intensity of Communication and Coordination of Government Officials on Twitter Social Media during the Covid-19 Handling in Indonesia	The role of Twitter in facilitating communication and coordination among Indonesian government officials during the Covid-19 pandemic.	High level of interaction and synchronization among officials, emphasizing unity and collaboration in managing the pandemic. Variation in focus between officials at different levels.	Primary search
Mohammed and Ferraris (2021)	Factors influencing user participation in social media: Evidence from	Examining the factors that influence active participation on Twitter during a	Attitude, perceived behavioral control, subjective norms,	Primary search

	twitter usage during COVID-19 pandemic in Saudi Arabia	crisis, specifically during the COVID-19 pandemic in Saudi Arabia.	utilitarian and hedonic values, and trust significantly affect Twitter users' active participation during a crisis.	
Karimiziarani et al. (2022)	Hazard risk awareness and disaster management: Extracting the information content of Twitter data	The role of Twitter in monitoring and analyzing the behavior of urban communities during natural hazards, using Hurricane Harvey as a case.	Proposed Hazard Risk Awareness (HRA) Index mapped across affected counties during Hurricane Harvey. Twitter provided real-time communication and information that traditional media may lack.	Primary search

2.3 The Future of "X" and the Combination with the Metaverse

Musk's strategic vision for the platform encompasses a multifunctional "Everything App," (Bullas, 2023) analogous to WeChat in China. This ambitious application is intended to serve as a digital identification system, an investment platform, and a cryptocurrency wallet, among other utilities. Navigating this multifaceted landscape while adhering to privacy regulations poses a formidable challenge. In a bid to allay advertiser concerns, Musk has transitioned from the role of CEO to assume the positions of Executive Chair and Chief Technology Officer, thereby concentrating on technological enhancements. Despite this move, concerns linger regarding the platform's moderation policies and operational stability, particularly following substantial staff

reductions. The introduction of a subscription-based revenue model for content creators allows them to monetize their contributions and retain 97% of the revenue, up to a lifetime earning cap of $50,000 (Bullas, 2023). Musk, a strong advocate for unrestricted expression, has implemented radical changes, including new services, the reintroduction of controversial figures, and a significant reshuffling of staff. These shifts have put the company under scrutiny from both the Federal Trade Commission and the European Union, which are calling for stringent security and privacy protocols. Additionally, there's the looming issue of financial viability as key advertisers retreat amid the turmoil. The company now faces four conceivable futures: potential bankruptcy due to declining ad revenues; an increase in extremist content owing to more relaxed moderation policies; technical difficulties resulting from a reduced engineering team; or survival through the introduction of innovative premium services that could bring in alternative revenue streams (Darell M. West, 2022).

Skepticism abounds concerning the platform's trajectory under Musk's influence, particularly in relation to potential lapses in content moderation. However, optimists argue that Musk’s proven resilience in corporate leadership, as demonstrated in his tenure at Tesla, suggests he could successfully navigate the precarious balance between free speech and responsible moderation. Therefore, the future of "X" under Musk’s guidance remains a subject replete with both opportunities and obstacles, and is consequently a focal point of rigorous debate and expectation (Bullas, 2023). While skeptics worry about the platform becoming a breeding ground for misinformation and extremism, optimists argue that Musk's track record of corporate resilience could help the company successfully navigate this perilous landscape. It's worth noting that these scenarios are not mutually exclusive; Musk, known for his tolerance for controversy, may well steer Twitter into a future that incorporates elements of all four. Amid these complexities, the path forward for Twitter now torn between ideals of free speech and the practicalities of operational and ethical responsibility is poised to be anything but straightforward (Darell M. West, 2022).

2.3.1 The Metaverse Concept and Applications

While the future of "X" under Musk is fraught with complexities, from ethical concerns of moderation to its multifunctional ambitions, it becomes an intriguing counterpart to the Metaverse's efforts to redefine how we interact in virtual 3D spaces. Both innovations Musk's rebranded social media platform and the emerging Metaverse stand as pivotal focuses of debate and expectation, each embodying a different facet of our evolving relationship with technology.

The Metaverse, a term first coined by author Neal Stephenson in his 1992 novel "Snow Crash," has become a concept to define virtual 3D environments. In these digital realms, people can interact with each other and their surroundings, unfettered by the physical constraints of reality (Narin, n.d.). The metaverse has since been adopted by educational researchers to characterize digital environments where learners interact and socialize using technologies such as augmented reality (AR), virtual reality (VR), mixed reality, avatar-based learning platforms, and Second Life software (Ng, 2022). CitySpace, active from 1993 to 1996, was the inaugural Metaverse. Following this, a host of other Metaverses such as Active Worlds and There (found at www.there.com) were developed. The most well-known among these is Second Life (SL, available at www.secondlife.com), a creation of Linden Lab in 2003. SL flung open the gates of web-based Virtual Worlds (VWs) to gaming aficionados. It offered its users an alternate universe where they could craft their own avatars and control every aspect of them, limited only by their creativity. In this digital domain, an individual could socialize, acquire property, design, and even carry out a range of activities - from the mundane to the fantastical - including pursuing higher education. SL fostered its own economy, complete with its own currency, the Linden Dollar. Interestingly, the Swedish government established a diplomatic presence in SL, with numerous cities, universities, artists, and individuals building virtual assets within this space (Narin, 2021).

Jeon, 2022 explores how individuals process and engage with social media content within the metaverse, a virtual world where users can experience an idealized "future self". The study uses gaze tracking and social media metrics to observe how users interact with various content, such as news feeds, adverts, and health marketing posts, in a simulated metaverse environment. The theory proposed here suggests that the further

the temporal distance between the actual and the simulated self, the longer the user pays attention to social media content. However, this may depend on the user's self-perception; those with negative self-views might show shorter attention spans, while those with positive self-views could exhibit longer attention spans. Metaverse platforms like Zepeto, VRChat, and Second Life let users live simulated social lives, creating avatars and engaging in activities that mirror real life. It's also increasingly common for users to access media within the metaverse, making it a potential avenue for businesses and marketers. (Jeon, 2022).

The metaverse has leveraged technological progress and has evolved significantly over time. A decade ago, the metaverse was predominantly viewed as a digital counterpart to real-world socialization where users, represented by avatars, could interact with each other. With advancements in artificial intelligence, blockchain technology, advanced mobile networks like 5G, and the Internet of Things, the metaverse has transformed into an immersive, 3D, virtual multi-user environment. In particular, Second Life has served as a crucial virtual platform for two decades. Earlier versions of the metaverse were primarily desktop-based, encompassing different virtual worlds and social simulation platforms like The Sims and OpenSimulator. With the advent of VR and other emerging technologies, the focus has shifted towards more socially interactive and collaborative experiences. The metaverse concept gained substantial attention around 2020, a shift underscored by Facebook's rebranding to Meta. This rebranding marked a significant shift in how students engaged in the digital world. The forced shift to remote teaching due to the pandemic further encouraged educators to explore alternative modes of communication and collaboration in the virtual world. In this context, the metaverse offers revolutionary opportunities across various industries to enhance user experiences, including social activities such as meetings, project collaboration, gaming, and learning in virtual environments (Ng, 2022).

The Metaverse, a digital universe with multifaceted social implications including fashion, gaming, education, and professional workspaces, is based on immersive interactions. It uses cryptocurrencies such as Dime as an economic link between the digital realm and the physical world, thereby enhancing the depth of its social significance. For large-scale Metaverse implementation, three elements are necessary: hardware enhancements such

as improved GPU memory and 5G technology; the creation of a recognition and expression model that effectively utilizes the concurrent processing capabilities of the hardware; and the existence of content that engages users and promotes active participation (Park and Kim, 2022). Although some argue that the metaverse is just a new label for existing technologies, it introduces unique characteristics of being "shared", "persistent", and "decentralized". Unlike AR, VR, and simulations, which primarily offer virtual content and environment, the metaverse provides a shared social connection among users. It transcends the functionalities of multi-user interactive systems such as Second Life that allow identity changes and interactions. The metaverse offers a persistent world or culture enabling users to live, work, learn, and create.

The term metaverse entails more than just incorporating AR, VR, simulations, or Second Life applications (Ng, 2022). The Metaverse is distinct from augmented reality (AR) and virtual reality (VR) in three key ways. Firstly, whereas VR research primarily concentrates on the physicality and visual rendering, the Metaverse emphasizes its nature as a service that offers enduring content and societal relevance. Secondly, the Metaverse does not necessarily rely on AR and VR technologies. Even without AR and VR support, a platform can be a part of the Metaverse. Finally, the Metaverse requires a scalable environment capable of accommodating numerous participants, which is fundamental to strengthening its societal relevance (Park and Kim, 2022). It embodies "shared", "persistent", and "decentralized" features, which should be considered when defining whether a technology belongs to the metaverse. This perspective offers a new vision for educational technology. (Ng, 2022)

2.3.2 Metaverse and Fashion: Redefining Style in the Digital Age

In an era where the digital and physical realms are increasingly intertwined, the COVID-19 pandemic acted as a catalyst, accelerating transformations across various industries. Among them, the fashion industry stands as a striking example. Long celebrated for its artistry and creativity, the fashion world is now navigating an unprecedented shift—one that extends beyond the conventional boundaries of fabric and thread into the virtual expanses of the Metaverse. As physical stores shuttered in response to global lockdowns, e-commerce boomed, and the Metaverse became a burgeoning frontier for fashion. This new, immersive digital universe, where the traditional catwalk is replaced by virtual

showrooms and users engage as personalized avatars, is not merely a novelty. It is a fast-evolving market with significant economic potential.

In response to COVID-19, the fashion industry witnessed a significant shift towards e-commerce, quickening its adoption of a virtual domain, the Metaverse. This immersive digital universe, where users interact as avatars, caters to a wide consumer base, offering fresh opportunities for economic, social, and recreational activities. By 2028, the Metaverse market is expected to generate a staggering USD 872.35 billion in revenue, with fashion being a crucial segment (Kim and Lee, 2022). This progression presents fresh opportunities for fashion firms to widen their retail scope and provide virtual consumer experiences. Alongside this, a surge of digital-only fashion brands has emerged, with giants like Gucci, Nike, and Ralph Lauren launching virtual collections or collaborating with Metaverse platforms. This research by Kim and Lee (2022) aims to examine the spread of this new trend within the fashion industry, potentially assisting retailers in crafting strategic marketing plans for the Metaverse marketplace. Despite its potential for a captivating 3D shopping experience, there's a research gap concerning the Metaverse's impact on the fashion industry. This study attempts to fill this gap by analyzing Twitter conversations related to Metaverse adoption in the fashion industry, using social network analysis (SNA), a method that investigates connections between network entities. This study explores key research questions: What are the communication dynamics in the network discussing fashion and the Metaverse on Twitter? Who are the central contributors to Metaverse adoption in the fashion industry? The study analyzed online conversations about the Metaverse on Twitter during the "Big Four" fashion weeks of 2022, employing SNA to understand network dynamics and community identification. The resulting data displayed a network of 8,746 tweets from 5,385 Twitter users. To understand the prominent communities, the research identified each community's key entity. Some communities showed higher two-way communication, reflecting significant attention towards the Metaverse fashion week and traditional brands' digital collections. Twitter interactions highlighted the expansion of the fashion marketplace to the Metaverse. Key communities engaged in mutual communication about the blend of Metaverse fashion and reality, with the media playing a crucial role in spreading this new trend. For Metaverse fashion brands, incorporating

elements of reality in their merchandise could attract consumers unfamiliar with the virtual world. (Kim and Lee, 2022).

2.3.3 Metaverse and Commerce

In an increasingly digital world, the concept of the Metaverse is capturing imaginations and headlines alike. It represents a new frontier—a collective, virtual shared space created by the convergence of physically enhanced virtual reality and persistent virtual space. This ambitious and expansive digital universe promises to revolutionize not just how we interact socially, but also how we conduct business and commerce. As we stand on the cusp of this new era, the fundamental technologies powering the Metaverse are drawing keen attention. They are the building blocks that are turning science fiction into reality, knitting together digital and physical worlds in unprecedented ways. Central to this discussion are several groundbreaking technologies: 6G communications, artificial intelligence (AI), virtual reality (VR), augmented reality (AR), digital twins, and blockchain. These technologies are poised to serve as the critical enablers that make the Metaverse not only possible but also practical and immersive. For instance, Extended Reality (XR)—comprising AR and VR—promises to redefine human interaction with digital information, while digital twins create a bridge between physical objects and their virtual counterparts. Blockchain technology, meanwhile, plays a vital role that extends far beyond cryptocurrency transactions. It is setting the stage for a new kind of economy—one where digital and physical assets can be traded on equal footing, and ownership and transactions are secure, transparent, and decentralized. In this context, Non-Fungible Tokens (NFTs) are emerging as a key concept. These unique, irreplaceable tokens are changing the way we think about ownership and value, giving virtual items a tangible sense of worth.

The metaverse relies on several enabling technologies, including 6G, artificial intelligence (AI), virtual reality (VR), and digital twins. These technologies play a crucial role in bringing the metaverse to life. Extended reality (XR) technology, comprising augmented reality (AR) and virtual reality (VR), is essential for the metaverse. AR overlays digital information onto the physical environment, while VR immerses users in a vivid digital world. XR enables users to interact within the metaverse, blurring the boundaries between the digital and physical realms. Digital twin technology creates

virtual replicas of real-world objects by utilizing real-time data to simulate their behavior. In the metaverse, digital twins mirror the real world, allowing for exploration and experimentation within a virtual environment. They enable the metaverse to find solutions to real-world challenges and enhance our understanding of complex systems. Blockchain technology serves two vital roles in the metaverse. Firstly, it acts as a decentralized and secure data repository, enabling users to store and access information across the metaverse. Secondly, blockchain establishes an economic framework that connects the virtual metaverse with the real world. Non-fungible tokens (NFTs), built on blockchain, empower virtual assets with real-world value, allowing users to trade and own virtual items as they would physical objects. Blockchain bridges the gap between the virtual and physical realms, facilitating seamless transactions and fostering a robust virtual economy (Gadekallu et al., 2022). With decentralized technologies like blockchain and non-fungible tokens, users' personal property and activities in the metaverse can be protected, ensuring secure economic transactions (Ng, 2022). The Metaverse, built upon blockchain technology, guarantees the uniqueness of all owned or generated items, making them impossible to duplicate or steal. Similar to unique art pieces, this technology ensures that digital commodities exchanged within the Metaverse are unique. Moreover, cryptocurrencies, which act as the lifeblood of the Metaverse, facilitate all transactions. Non-Fungible Tokens (NFTs) are a frequently used concept within the Metaverse. These tokens are exclusive cryptographic tokens that are non-replicable on a blockchain. NFTs can symbolize tangible real-world items and function as collectible digital assets, holding value just as physical assets do. For instance, a plot of land within the Metaverse would be classified as an NFT. Given that the Metaverse is based on blockchain, the same technology that underpins cryptocurrencies, these digital currencies are set to become the predominant form of payment within this digital universe. Utilizing cryptocurrency for transactions is likely to be the easiest, most efficient, and cost-effective method for conducting a global shopping spree within the Metaverse. You can spend your cryptocurrency in any store, irrespective of its location, without incurring additional costs related to international communication or transactions. The majority of stores within the Metaverse are expected to accept all major cryptocurrencies (Laeeq, 2022.).

2.3.4 Metaverse, Social Media, and Marketing: Building Virtual Communities and the Rise of Virtual Influencers

In an era characterized by rapid technological advancements and the blending of our digital and physical lives, the concept of the Metaverse has emerged as a compelling vision for the future of human interaction. The Metaverse, a network of interconnected, immersive 3D virtual environments, promises a digital frontier where individuals can work, play, socialize, and create in ways previously confined to the realms of science fiction. It aspires to be more than a collection of virtual worlds—it aims to function as an expansive, digital society complete with its own cultures, economies, and opportunities. While virtual environments have existed for decades, evolving from rudimentary text-based interfaces to intricate and visually stunning 3D worlds, we now stand at the cusp of a significant transition. The challenge at hand is to progress from isolated digital spaces into a cohesive and interconnected Metaverse, where users can seamlessly travel between worlds, maintaining consistent identities and carrying assets and information along with them. It is a concept that represents not just a technological evolution, but a profound shift in how we understand and engage with digital spaces.

Over the past thirty years, virtual worlds have evolved from text-based environments to complex, immersive 3D realms. These increasingly realistic environments now serve as contexts for work, play, socialization, and creativity, functioning more like digital cultures than games. However, a new challenge arises: transitioning from standalone virtual environments to an integrated network of 3D worlds, or a Metaverse, mimicking the complexity of human interaction and culture. Success in this endeavor hinges on four central elements: realism, ubiquity, interoperability, and scalability. The first, realism, involves the quality of immersion. While advancements in sight, hearing, and touch simulation continue, they remain a step behind due to the need for bidirectional information flow and real-time performance. To effectively simulate a reality within the Metaverse, these innovations must be synchronized and integrated. Ubiquity addresses the accessibility of the Metaverse through existing digital devices and maintaining the user's virtual identity throughout. While advances in ubiquitous computing help the former, achieving the latter requires a more focused effort, especially given the currently fragmented nature of digital identities across various platforms. Interoperability is the third requirement. For a seamless Metaverse experience, virtual worlds must support the

transfer of 3D objects, communication protocols, identities, and even virtual currencies across different environments. Although standards like VRML, X3D, and COLLADA have been proposed, none have become dominant. This remains a challenge due to the social and political complexities involved. Lastly, scalability ensures the Metaverse can accommodate a vast number of concurrent users efficiently. Achieving this requires a shift from centralized architectures to more distributed ones, possibly including peer-to-peer approaches and load distribution strategies tailored for virtual worlds. The optimism for the realization of a Metaverse comes from several fronts. Institutions like the National Academy of Engineering have identified enhanced virtual reality as a key area of focus. Public interest continues to surge, with registered virtual world accounts growing exponentially. Moore's law and Kurzweil's law predict continuous hardware improvements, suggesting sufficient computational power will be available for real-time operations in virtual worlds (Dionisio et al., 2013).

As the digital world evolves, the Metaverse is emerging as a revolutionary platform, redefining the boundaries between virtual and physical realities. In this new frontier, opportunities for marketing are burgeoning, offering fresh and immersive avenues to engage with consumers. In contrast to its antecedents like Second Life and SIMS, the Metaverse, powered by Web 3.0 technologies, is far more intricate, promising deeper user engagement through augmented reality, artificial intelligence, and blockchain-enabled transactions. In this dynamic context, a novel phenomenon is capturing attention: virtual influencers. These digital entities, designed to interact with consumers in lifelike ways, are becoming key players in the marketing strategies of forward-thinking brands. Yet, the Metaverse is a landscape still under exploration, with unique challenges tied to technology, consumer psychology, and socio-cultural factors. This chapter delves into the intersection of the Metaverse and marketing, focusing on the rise of virtual influencers. We will explore how these digital personalities are influencing consumer behavior, the psychological factors that drive engagement with these influencers, and the strategic considerations that companies must navigate in this evolving digital landscape.
The metaverse, a virtual world with immersive capabilities, is expected to parallel the real world. Early platforms like Second Life and SIMS served as antecedents to the metaverse, providing users with a glimpse into virtual living. However, these platforms were limited in scope and mainly focused on gaming during the web 2.0 era. With the

advent of web 3.0 technologies, the metaverse has evolved to incorporate augmented reality, reality-based conversations, artificial intelligence, deep learning, extended reality technology, and more. It offers better immersive capabilities, payment options using digital currencies, and enhanced content and services tailored specifically for the metaverse. Marketers see the metaverse as an opportunity to reach existing and potential customers in new and immersive ways. However, marketing in the metaverse is still experimental and presents unique challenges related to technology, socio-cultural factors, and strategic considerations. The COVID-19 pandemic has also accelerated the shift from physical stores to online platforms, and the metaverse adds another dimension to the retail landscape. Understanding changes in consumer behavior within the metaverse and its impact on brand value, awareness, engagement, and communication strategies is crucial for marketers. (Dwivedi et al., 2023).

The advent of the Metaverse promises new frontiers in mobility, collaboration, and connectedness within a digital universe that has the potential to digitize our world of work and commerce. The current study by Khan et al. (2023) seeks to delve into the influence of consumer neuroticism, parasocial relationships, social media influencers' credibility, and openness to the Metaverse experience on the intention to use the Metaverse digital marketplace. Drawing upon prominent theories such as the elaboration likelihood model and personality traits notion, a multi-path model has been developed to shed light on the intention to use the Metaverse digital marketplace. By analyzing extensive data from 1861 social media active users and utilizing covariance-based structural equation modeling (CB-SEM), novel findings have emerged, indicating that parasocial relationships and social media influencers' credibility play a positive role in triggering intentions to use the Metaverse digital marketplace. Furthermore, a higher inclination towards openness to the Metaverse experience strengthens the impact of parasocial relationships on the intention to use the Metaverse digital marketplace. Interestingly, openness to the Metaverse experience exhibits a negative association with consumers' neuroticism (Khan et al., 2023.). Brand communications in the metaverse require interaction through avatars, and marketers are exploring virtual marketing tools to create immersive experiences for consumers. Researchers are also delving into areas such as consumer well-being, ethics, creativity, and the generation gap within the metaverse (Dwivedi et al., 2023). The implications of this study provide fresh insights into the

significance of parasocial relationships and social media influencers' credibility in determining followers' intention to use the Metaverse digital marketplace. To expedite the transition to the digital marketplace, consumers with a predisposition towards neuroticism could benefit from professional support to overcome negative emotions, such as fear and helplessness, towards emerging digital technologies like the Metaverse. In today's digital landscape, people are increasingly turning to digital platforms and virtual communities for information and relationship-building purposes. Social media users frequently seek guidance and information from relatable individuals or popular online personas in various areas, including health, travel, food, lifestyle, beauty, and fashion. Over time, social media influencers have formed deep connections with their followers through the creation and sharing of user-generated content and constant interactions. As a result, these influencers hold significant sway over their followers' purchasing decisions. Marketers and companies recognize the marketing potential associated with influencers, as followers place a high level of trust in their endorsements and influencer-generated content. As people's attachments to social media influencers deepen with increased technology usage, there is a need to explore the desire to engage with the Metaverse and the factors that contribute to this decision. The Metaverse has garnered attention due to its potential to revolutionize mobility, collaboration, and connectedness, transforming the way we work and conduct commerce. However, the transition to the Metaverse has also given rise to intensified competition within the online marketplace, with various advertising strategies and electronic payment methods vying for consumers' attention. In response to this competitive landscape, online retailers are employing sophisticated technologies tailored to individual customer preferences, including spatial computing and geographic mapping. To establish parasocial relationships with their followers, social media influencers must embody attractive character traits that resonate with their audience. The interactions between influencers and their followers, as well as the reciprocity in the relationship, play vital roles in building these connections. Influencers must maintain good rapport with their followers by demonstrating appropriate etiquette, respect, and responsiveness to their followers' expectations and emotions. Additionally, marketers aiming to promote the usage of the Metaverse digital marketplace can select social media influencers who possess expertise in specific product categories. These influencers, with their domain-specific knowledge, can engage in positive behaviors when endorsing the Metaverse marketplace.

Furthermore, individuals with higher levels of uncertainty, such as neuroticism, are more likely to adopt the Metaverse digital marketplace when social media influencers provide accurate and relevant information to their followers. In conclusion, this study sheds light on the complex interplay between consumer neuroticism, parasocial relationships, social media influencers' credibility, openness to the Metaverse experience, and the intention to use the Metaverse digital marketplace. By understanding these dynamics, marketers and companies can tailor their strategies to leverage the power of social media influencers and foster a positive intention to use the Metaverse marketplace among consumers. Furthermore, providing professional support to consumers prone to neuroticism can help alleviate negative emotions and fears associated with emerging digital technologies, facilitating the transition to the digital marketplace (Khan et al., 2023.).

As research in marketing and the metaverse progresses, innovative research techniques like immersive netnography are emerging to study phenomenological service experiences. However, more research is needed to fully grasp the potential and implications of marketing in the metaverse. It is an exciting and evolving space that requires further exploration and the development of suitable research methods to understand its impact on consumer behavior and brand strategies (Dwivedi et al., 2023).
As the digital age advances, the concept of the Metaverse has emerged as a transformative force, reshaping sectors from fashion to commerce, and from social media to marketing. The Metaverse, envisioned as a collective virtual shared space created by converging physical and virtual reality, has sparked widespread interest and debate among scholars, practitioners, and innovators alike. The following table provides a concise summary of recent scholarly articles that delve into the nexus of the Metaverse with various domains. Grouped by thematic chapters, this table highlights the authorship, title, publication year, primary focus, core findings, and research methods of each study. Whether examining the symbiosis of fashion and the Metaverse or the revolutionary role of blockchain and cryptocurrencies in shaping virtual commerce, these curated studies offer profound insights into the evolving Metaverse landscape.

Table 9 : Metaverse and Fashion: Redefining Style in the Digital Age

Author & Year	**Title**	**Point of the Article**	**Basic Findings**	**Research Method**

Kim and Lee (2022)	Metaverse Buzz in the Fashion Industry: Social Network Analysis with Twitter Data Introduction	Analyzes the impact of the Metaverse on the fashion industry	Found a network of 8,746 tweets from 5,385 Twitter users, with key communities engaging in mutual communication about the blend of Metaverse fashion and reality. The media plays a crucial role in spreading this trend.	Primary search

Table 10 : Metaverse and Commerce

Author & Year	**Title**	**Point of the Article**	**Basic Findings**	**Research Method**
Gadekallu et al. (2022)	Blockchain for the Metaverse: A Review.	Role of blockchain in enabling the Metaverse.	Blockchain provides a decentralized, secure data repository and an economic framework.	Literature review
Ng (2022)	What is the metaverse? Definitions, technologies and the community of inquiry	Importance of blockchain for security in the Metaverse.	Decentralized technologies like blockchain ensure secure transactions and personal property in the Metaverse.	Literature review
Laeeq (2022)	Metaverse: Why, How and What	Usage of cryptocurrencies as a predominant form of payment in Metaverse.	Most Metaverse stores are likely to accept all major cryptocurrencies.	Literature review

Table 11 : Metaverse, Social Media, and Marketing: Building Virtual Communities and the Rise of Virtual Influencers

Author & Year	**Title**	**Point of the Article**	**Basic Findings**	**Research Method**
Dionisio et al. (2013)	3D Virtual worlds and the metaverse: Current status and future possibilities	Discusses the technological requirements for realizing a Metaverse.	Identifies realism, ubiquity, interoperability, and scalability as the four central elements required for the Metaverse.	Literature review
Khan et al. (2022)	Remodeling digital marketplace through Metaverse: A multi-path model of consumer neuroticism, parasocial relationships, social media influencers credibility, and openness to Metaverse experience	Factors influencing consumers' intention to use the Metaverse digital marketplace.	Parasocial relationships and social media influencer credibility positively influence intention to use Metaverse.	Primary search
Dwivedi et al. (2023)	Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy	Challenges and opportunities of marketing in the Metaverse.	Brand communications in Metaverse require new strategies; considerations include well-being, ethics, and creativity.	Literature review

2.4 Twitter in the Metaverse: Potential Scenarios and Implications

As we navigate further into the digital age, the Metaverse emerges as a groundbreaking concept that promises to reshape the boundaries of virtual and physical realities. This chapter delves into the intricate web of potential scenarios and implications concerning the integration of established social media platforms, particularly Twitter, within the context of this rapidly evolving Metaverse. Central to this exploration are the technologies of Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), each offering unique capacities for user interaction and immersion. This chapter provides a meticulous examination of VR's capacity to offer synthetic, fully immersive environments, and AR's capability to overlay digital content onto our physical world, as well as MR's potential as a harmonious blend of the two. As the Metaverse aspires to seamless integration and limitless interaction among users, technical challenges loom large, notably those pertaining to real-time interaction, presence, and multi-user collaboration, which are essential for platforms like Twitter. Simultaneously, this chapter casts a critical eye on the societal and psychological impacts of such integration, investigating issues related to mental health, identity, privacy, and potential inequalities in access. We also ponder the role of AI agents in future customer interactions within the Metaverse and scrutinize the ethical and legal frameworks that may need to evolve in concert with these novel virtual environments. Ultimately, this chapter seeks to contribute a comprehensive and rigorous analysis to the discourse surrounding the fusion of social media platforms with the Metaverse—a digital frontier that, while offering unprecedented opportunities for connection and interaction, also ushers in a new era of challenges that demand thoughtful consideration and proactive engagement.

Virtual Reality (VR) offers entirely synthetic views and is characterized by fully virtual environments where users interact using techniques such as head tracking and tangible controllers. In VR, users are completely immersed in the virtual world, detached from physical reality. Modern VR environments allow users to create content, such as VR painting, and collaborate with others in real-time. To ensure a seamless experience, VR requires shared space, presence, real-time interaction, communication methods (gestures, text, voice), and information sharing and manipulation among multiple users. The

challenge in building the metaverse within VR lies in synchronizing and managing the dynamic states/events of virtual spaces to accommodate unlimited concurrent users without noticeable latency.

Augmented Reality (AR) enhances users' physical surroundings by overlaying digital content through various perceptual channels like audio, visuals, smell, and haptics. AR initially focused on visual enhancements, but significant research has been conducted to improve user interactions with digital entities in AR. Seamless and lightweight user interaction is a key challenge in merging the physical world with the metaverse through AR. Freehand interaction techniques, like Voodoo Dolls and HOMER, have been explored to enable intuitive AR user interactions. AR will integrate with our urban environments, allowing digital entities to appear alongside physical objects. AR headsets, though not the only option, offer advantages like uninterrupted user attention and free hands.

Mixed Reality (MR) lies between AR and VR on the Reality-Virtuality Continuum, but there is no universally agreed-upon definition. Commonly, MR allows users to interact with virtual entities in physical environments, demonstrating interoperability between digital and physical objects. MR is seen as a starting point for the metaverse, where digital twins connect to the physical world, and users create content in them. The metaverse aims to merge digitally created content seamlessly with the physical surroundings across space and time. MR prototypes align with the metaverse's goals of multiple virtual worlds working together, pursuing realism, presence, and creating empathetic physical spaces (Lee et al., 2021).

The dawn of the Social Metaverse is set to redefine traditional social networks by turning them into immersive, interactive 3D virtual realities. This transformative shift has been triggered by the fusion of virtual reality and social networking technologies, leading to the creation of 3D interactive social spaces. Unlike standard content-based social networks, these novel platforms allow users, represented by avatars, to engage with others, partake in events, and even carry out transactions with real-world money in a range of virtual settings. These platforms are complex systems that seamlessly merge physical and virtual social interactions through an innovative design known as cyber-physical-social-systems. To achieve a smooth blend of physical and virtual social

interactions, consistent tracking of social events within the virtual environment is crucial. Moreover, to satisfy user expectations, the virtual social environment needs to follow four fundamental design principles: realism, to ensure users feel emotionally connected; ubiquity, to make the platform accessible from multiple devices and locations while maintaining user's virtual identities; interoperability, to allow users to transition seamlessly between different virtual locations within the Metaverse; and scalability, to manage computational power effectively, thus allowing large numbers of users to interact without disruptions (Ning et al., 2021). In the Metaverse, people can live a balanced cyber life, clearly distinguishing it from reality, similar to discerning real life from an avatar movie. Still, avatar creation can pose emotional challenges due to the Uncanny Valley effect, potentially leading to a feeling of disconnect. Memories are cherished as they mark unique moments. Interestingly, the Metaverse lets users revisit and make alternate choices in past experiences, promoting emotional healing and psychological stability. However, the Metaverse's social impact is intricate and relies on its ecosystem. Consideration of social inequalities, computational needs, economics, legality, and ethics is vital. Unlike the real world, with its limited resources and resultant competition, the Metaverse enables infinite creation and utilization of resources. This reduces competition among users, potentially encouraging collective growth and mutual benefits (Park and Kim, 2022).

Adding another dimension with nearly real-time interactions in the Metaverse may blur the line between the real and virtual world, potentially leading to prevalent mental health issues. Like any emerging technology, Metaverse Standardization presents challenges, mainly because all participants want to set the "standard" to control the market. These standards, covering all processes, protocols, and hardware/software, make interoperability a key facet of the Metaverse's design and implementation. Prioritizing humans is crucial for future sustainability and resilience in all Human Robot Collaboration (HRC) systems. Prof. Wang suggests a future-oriented perspective of four Enhanced Human Abilities (EHAs): augmented robot, cognitive system, mixed reality, and co-intelligence, all aimed at assisting, empowering, and advising human operators. Enabling platforms are core or general software applications that boost the XR software ecosystem by adding functions like operating systems, digital stores, real-time engines, world mapping, and cloud rendering. Content platforms support the acquisition, creation,

and management of 3D content needed to populate the Metaverse, like digital twins or virtual environments. Human-centered platforms manage content linked to human representations and virtual beings. Utility platforms are tasked with filling the Metaverse with applications and utility-based use cases, such as new search engines and low code application platforms (Mourtzis et al., 2022).

The goal by Lee et al. (2021) is to create a seamless connection between the physical world and its digital counterparts, enabling users to interact with avatars and virtual objects in both realms. Traditional input methods like keyboards and mice are deemed insufficient due to their limited ability to accurately reflect avatar movements and their lack of mobility. To address these challenges, researchers have been exploring alternative input techniques. Examples include on-body user interaction, where users can interact with capacitive surfaces attached to their bodies. Additionally, digital textiles integrating conductive threads into fabrics enable users to interact with 2D and 3D user interfaces. The emergence of mobile headsets offers a promising channel for displaying virtual content in physical environments. However, challenges such as limited Field of View (FOV) need to be addressed to improve user experience. User feedback cues, such as visual, audio, and haptic feedback, play a critical role in enhancing realism and user immersion. Haptic feedback, in particular, compensates for the lack of physical touch in virtual environments. Various mobile haptic devices have been explored to achieve this. Telepresence, the feeling of being present in a remote environment, is an essential aspect of the metaverse. Delivering haptic stimuli with low latency and high bandwidth presents significant challenges. The concept of the Tactile Internet has been proposed to redesign the Internet backbone and achieve ultra-reliable tactile feedback for real-time haptic interactions in the metaverse (Lee et al., 2021).

Consumer engagement plays a crucial role in developing customer loyalty and brand equity, and there is increasing evidence supporting the benefits of transitioning these interactions to a virtual setting through parasocial interaction. Recent research highlights the significance of AI in digital marketing platforms and consumer engagement. Based on this, it's projected that consumer interactions within the Metaverse will primarily be with AI agents designed to learn from repeated customer engagements, as opposed to human company representatives. Such interactions will surpass service exchanges with virtual call center assistants or service robots and potentially include virtual

"companions" who are desired, or at least accepted, as interaction counterparts. AI agents will be ubiquitous in a future Metaverse, ranging from virtual salespeople at car dealerships (selling or leasing real or virtual cars) to virtual tour guides and brand influencers intended to link users with the brand. This suggests that Metaverse marketing might transition from "traditional" influencer marketing to leveraging interactive, humanoid AI agents for personalized customer interactions, such as virtual 3D AI agents in VR or holograms in AR. The Metaverse, therefore, is anticipated to dramatically transform customer, brand, and employee experiences due to the altered perception of reality and how the environment, personal embodiment, and presence of others are experienced (Dwivedi et al., 2022).

While probing Virtual Reality (VR), teletherapy, and telework, the subject of social media demands attention. Despite risks, it thrives due to human needs for connection, which extends to the metaverse—a concept combining social media with VR. This integration prompts questions similar to those around social media, such as potential addiction, the exacerbation of mental health issues, or unhealthy lifestyles. The virtual embodiment might also heighten bullying and abuse, as anonymity in the metaverse emboldens harassment. Haptic technology, allowing users to physically feel virtual interactions, adds to the concerns.

Social media's impact is multifaceted, depending on usage and individual differences, and its utility is undeniable. These complexities are expected to carry into the metaverse, not as negatives but as areas for scrutiny. The metaverse's social aspects may even present research opportunities to study social dynamics.

Moreover, the metaverse may signify a transformative step in social media. Presently accessed through devices like phones, the transition to VR headsets in the metaverse would immerse the user in a social world. This immersive experience could redefine our relationship with social media, making our virtual selves subject to this digital realm's pressures, potentially altering perceptions of identity and self-esteem.

In summary, the integration of social media into the evolving concept of the metaverse raises many questions and concerns paralleling those associated with current social media usage. The potential for addiction, negative impacts on mental health, and new avenues for harassment are all important considerations. However, the metaverse also

offers potential for innovation, research, and a new layer of social interaction. Careful examination and thoughtful engagement will be key to navigating this new frontier in digital social connection (Benhimoh et al., 2022).

The metaverse represents a revolutionary shift in entertainment, enabling users to craft avatars and immerse themselves in virtual realms for various artistic and recreational pursuits. Its fusion of unfamiliar yet relatable environments provides a new entertainment dimension. A by Ananya Babu et al, (2022) survey reveals 70.9% believe the metaverse will reshape the future, with 20.9% uncertain, and a majority foreseeing the most significant benefits in the entertainment industry. As the next evolution of the internet, the metaverse allows users to build virtual lives, socialize, conduct transactions, and collaborate. Virtual reality gaming is a particularly influential aspect, and 58.6% of survey respondents agreed it is the next internet evolution, while 16.4% disagreed, and 25% were unsure. Although in its early stages, tech and entertainment giants are investing heavily in the metaverse's future, recognizing its potential even in its infancy as an entertainment medium. It offers novel possibilities across entertainment, music, gaming, arts, and fashion, enhancing user experiences. In the music industry, virtual concerts are becoming feasible, with companies like South Korea's Netmarble planning K-pop metaverse concerts.In theme parks, the metaverse offers more efficient and safer development alternatives, with Disney recently obtaining a patent for incorporating metaverse features. The gaming sector also expects significant growth, with major investments from game developers and venture capital firms. The blending of augmented and mixed reality into a unified experience provides gamers with unparalleled flexibility, allowing them to effortlessly transition between various virtual experiences. The metaverse is poised to redefine the entertainment landscape, presenting new avenues for creativity and collaboration (Ananya Babu et al., 2022).

3 Discussion

In this comprehensive exploration of Twitter's multifaceted roles, this discussion chapter delves into the evolution of Twitter from its early days to its current significance in shaping communication, social activism, political discourse, marketing, and crisis management. The historical perspective, illuminated by pioneering studies such as Java et al. (2007) and Kwak et al. (2010), provides a foundational understanding. Twitter's transformative power as a tool for social activism and political expression, as evidenced by the works of Bruns et al. (2013) and Tufekci (2018), is examined in detail. Additionally, the platform's vital role in political communication, marketing strategies, and crisis response is dissected through studies by Golbeck et al. (2010) and Pentina et al. (2013). Recent research illuminates contemporary trends, including Twitter's impact on news dissemination and public opinion, and its role in the metaverse, as showcased by studies from Osmundsen et al. (2021) to Dwivedi et al. (2023). This chapter not only synthesizes key findings but also outlines future trajectories, offering valuable insights into the dynamic landscape of Twitter and its intersection with emerging technologies. The table 12 summarizes the above.

Table 12 : A taxonomy of thesis' articles

Studies on the use of Twitter in the past	**Twitter's impact on communication and information sharing**	Java et al. (2007),Kwak et al. (2010),Lovejoy et al. (2012),Papacharissi & de Fatima Oliveira (2012),Hermida et al. (2014),Birnbaum et al. (2019)
	Twitter as a tool for social activism and political expression	Bruns et al. (2013),Conover et al. (2013),Tufekci (2018)
	Twitter's role in political communication	Golbeck et al. (2010),Yardi and Boyd (2010),Ammann (2010),Lassen and Brown (2011),Hong and Nadler (2011),Tumasjan et al. (2011),Conover et al. (2011),Larsson and Moe (2011),Stieglitz and Dang-Xuan (2013),Jungherr et al. (2016)

	Twitter's role in marketing and advertising	Pentina et al. (2013),Jin and Phua (2014),Barry et al. (2016),Murillo et al. (2016),Pike JR et al. (2019)
Recent studies on the use of Twitter / X nowadays	**Twitter's role in news dissemination and information sharing**	Osmundsen et al. (2021),Murayama et al. (2021),Yao et al. (2021)
	Twitter as a platform for social interactions and community building	Mosleh et al. (2021),Saima Sadiq et al. (2021),Arslan et al. (2022)
	Twitter's impact on public opinion and sentiment analysis	Hu T, et al. (2021),Shofiya and Abidi (2021),Lyu et al. (2021),Naseem et al. (2021),Valle-Cruz et al. (2022),Marcec and Likic (2022),Hassan et al. (2022)
	Twitter's role in crisis communication and emergency response	Wang et al. (2021),Behl et al. (2021),Bashir et al. (2021),Machmud et al. (2021),Mohammed and Ferraris (2021),Karimiziarani et al. (2022)
The Future of "X" and the Combination with the Metaverse	**The Metaverse Concept and Applications**	Kim and Lee (2022)
	Metaverse and Fashion: Redefining Style in the Digital Age	Gadekallu et al. (2022),Ng (2022),Laeeq (2022)
	Metaverse, Social Media, and Marketing: Building Virtual Communities and the Rise of Virtual Influencers	Dionisio et al. (2013),Khan et al. (2022),Dwivedi et al. (2023)

The rapid evolution of social media platforms has redefined the way societies interact and share information globally. Twitter, once a microblogging site, has emerged as a linchpin in real-time information dissemination. Its unrestricted nature and hashtag usage have transformed it into a vital crisis management tool, outpacing even official seismic networks in reporting natural disasters. Twitter's Application Programming Interfaces (APIs) have empowered researchers, enabling diverse data collection and analysis methods, including event detection techniques. The platform's pivotal role spans historical contexts, current applications, and even the uncharted territories of emerging technologies like the Metaverse. This multifaceted role of Twitter underscores its influence on global communication paradigms, political expression, and crisis management strategies.

In parallel, the digital landscape is being reshaped by the Metaverse, a transformative force converging physical and virtual reality. The Social Metaverse, a paradigm shift, redefines social networks into immersive 3D virtual realities. This evolution, driven by the fusion of virtual reality and social networking technologies, introduces users to interactive social spaces. Avatars, representing users, engage in events and transactions, challenging the conventional boundaries of online interaction. However, the Metaverse's potential is intricately woven with complexities. Design principles such as realism, ubiquity, interoperability, and scalability are crucial in blending physical and virtual interactions seamlessly. Moreover, the Metaverse provides a unique opportunity for emotional healing, enabling users to revisit and reevaluate past experiences, promoting psychological stability.

Yet, this transformative potential comes with challenges. Understanding the Metaverse's social impact demands meticulous consideration of social inequalities, computational requirements, economic factors, legality, and ethics. Notably, the Metaverse, unlike the physical world, offers infinite resources, potentially fostering collaborative growth and mutual benefits among users. Blockchain technology and Non-Fungible Tokens (NFTs) underpin the Metaverse, ensuring the security and uniqueness of virtual assets. Cryptocurrencies emerge as the backbone, facilitating global transactions and making virtual interactions efficient and cost-effective.

In the realm of politics and activism, Twitter has emerged as a potent tool, democratizing political engagement and reshaping public discourse. Political figures, parties, and citizens leverage Twitter to express opinions, mobilize support, and engage directly with the public. The rise of technoactivists and political blogs further illustrates the platform's transformative role. However, challenges persist, including the balance between information control and interactive engagement. Political actors often struggle to adapt to the digital format, leading to a cautious approach online, resembling electronic brochures rather than interactive forums.

As research delves deeper into the Metaverse and its implications for marketing and social networking, innovative methodologies like immersive netnography are illuminating new facets of consumer experiences. However, the Metaverse remains largely unexplored, necessitating comprehensive research to understand its profound impact on consumer behavior and brand strategies.

In essence, the digital frontier is marked by transformative technologies like Twitter and the Metaverse. Twitter's journey from a microblogging platform to a global communication powerhouse is emblematic of the evolving digital landscape. Simultaneously, the Metaverse, bridging physical and virtual realities, presents unprecedented opportunities and challenges. Understanding the nuances of these technologies is vital in shaping a responsible and equitable digital future. This chapter underscores the need for adaptability, ethical considerations, and robust research methodologies in navigating these digital frontiers, ensuring a transformative yet responsible digital age for all.

Twitter's evolution, as outlined in our analysis, provides a compelling narrative on the relationship between digital platforms and changing societal dynamics. Historically, Twitter introduced unprecedented changes in how we communicate. Its capacity for instantaneous communication democratized the spread of information, altering the contours of global discourse. This transformation gave rise to grassroots initiatives, propelling them from local narratives to global stages, while offering political figures a direct, transparent channel to connect with the masses.

However, the tale of Twitter's metamorphosis doesn't end there. While its inception focused on information broadcasting, recent developments have pivoted towards cultivating rich digital ecosystems. These spaces are characterized by engagement, discussion, and collective experiences. Further diversifying its roles, Twitter has positioned itself as a cornerstone in sentiment analysis, gauging real-time public sentiments. This capability has implications spanning various sectors, from business approaches to governmental policies.

In moments of global turmoil or unexpected crises, Twitter's role shines, serving as a pivotal source for real-time information, advisories, and communal solidarity. As we stand at the cusp of the Metaverse era and augmented realities gain traction, digital platforms face a new set of challenges and possibilities. For entities like Twitter, this means blending established functionalities with the nuances of expansive virtual realms. Ultimately, Twitter's journey underscores the continually adapting nexus between technological progress and society's evolving needs.

4 Conclusion

Twitter's transformational journey, as highlighted in this paper based on literature review, emphasizes its pivotal role in reshaping various domains, including communication, activism, politics, marketing, and digital information consumption. From its modest beginnings as a micro-blogging platform, its ascent into a global conversational powerhouse offers significant lessons on the dynamics of online interactions.

At its inception, the impact of Twitter on communication was profound. It introduced a medium that facilitated quick, succinct, and real-time dialogues. This innovation transformed the globe into a tightly-knit community, making it possible for news from any location to cross boundaries in mere moments. This immediate global outreach has redefined how news is accessed and consumed.

Historically, Twitter's significance in social activism and political discourse was also notable. Major movements like the Arab Spring and Occupy Wall Street leveraged the platform for ideological sharing and grassroots organization. Politicians and

governmental entities recognized its worth, employing it to directly engage with their followers, circumventing the traditional media barriers.

On the commercial front, businesses discerned the marketing potential of Twitter. They accessed live consumer feedback and devised campaigns that resonated instantly with their target audiences.

Yet, as revolutionary as these early impacts were, recent trends in Twitter usage depict a more complex web of online exchanges. In the realm of news dissemination, a symbiotic relationship has emerged between established news outlets and citizen reporters. This partnership amplifies the democratic essence of Twitter, where the boundaries between news creator and consumer are constantly redefined.

Moreover, today's Twitter “X” is more than just an information hub; it’s a venue for discussions, debates, and the genesis of virtual communities with shared objectives or interests. This evolving nature of the platform becomes even more evident in sentiment analysis. By gauging real-time public sentiment on Twitter, businesses and policymakers can make informed decisions ranging from product introductions to legislative moves. One of the standout contemporary uses of Twitter is its significance in crisis management and immediate response. Whether confronting natural calamities, acts of terror, or other emergencies, both official entities and the public rely on Twitter for swift updates, aid orchestration, and mutual support. What was once a unique feature of real-time communication is now a crucial tool during critical moments.

With the emergence of the Metaverse, or a unified virtual environment, platforms like Twitter face new horizons. As we delve deeper into digital worlds and augmented experiences, the next logical step for platforms like Twitter might be a transition from flat, textual exchanges to a more vivid, three-dimensional space where dialogues and community engagements have a more palpable presence.

To summarize, the evolution of Twitter offers more than just an account of a digital platform's success. It reflects the dynamic shifts in how humans interact in a digital age. As we prepare for forthcoming tech innovations, such as the expansive potential of the Metaverse, gleaning insights from Twitter's progression is essential, illuminating the path as we navigate the complexities and promises of our intertwined digital journeys.

The thesis comprehensively investigates the evolving role of Twitter in digital communication, ranging from historical contexts to its current state and its anticipated future within the Metaverse. It answers key questions about Twitter's impact on communication, social activism, political expression, marketing, news dissemination, community building, public sentiment analysis, crisis communication, and emergency response.

Furthermore, the temporal scope might limit the coverage of the most recent developments in Twitter's evolution, potentially impacting the thesis's relevancy. To address these limitations, future research could focus on comparative global analyses, conduct longitudinal studies to capture evolving trends, explore the ethical implications of Twitter's influence, investigate user behavior within virtual spaces linked to Twitter, and delve into policy challenges arising from its changing role. These avenues could enhance our understanding of Twitter's multifaceted impact in the digital age and its implications in the emerging Metaverse era, providing a more nuanced perspective on its societal and business significance.

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Κυρώσεις για λογοκλοπή

Η λογοκλοπή είναι ένα πολύ σοβαρό παράπτωμα. Με απόφαση της ΓΣΕΣ φοιτητής που διαπιστώνεται ότι υποπίπτει σε λογοκλοπή κατά την εκπόνηση της διπλωματικής του εργασίας αποβάλλεται από το ΠΜΣ. Εάν έχει ήδη αποφοιτήσει ανακαλείται το Μεταπτυχιακό δίπλωμα Ειδίκευσης και προωθείται το θέμα στο Δικαστικό Γραφείο του Πανεπιστημίου για την έναρξη των ανάλογων νομικών διαδικασιών.